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AN EVALUATION
OF A NEW METHOD FOR TEACHING
THE GRADE NINE CORRESPONDENCE COURSE
IN GENERAL SCIENCE

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF ARTS

DEPARTMENT OF EDUCATION

BY

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CHAPTER I

NATURE OF THE INVESTIGATION

1. Selecting the problem. - In selecting the problem for experimental investigation as outlined in this thesis, a careful analysis was made of modern textbooks and curricula in the field of general science for intermediate school grades. It was discovered that course designers in framing programmes, and classroom teachers in interpreting such programmes persist in thinking in terms of subject matter rather than in terms of children. This fact of misplaced emphasis led to a suggestion for needed reform in classroom procedure and guidance relative to the treatment of general science. Such needed reform has been recognized by the Progressive Education Association in its Eight-Year-Experiment but the research work of this organization has been limited to evaluation rather than investigations into remedial procedures.

Recognizing that science courses often lack human interest and that organization outlines are usually scientific and logical, a problem suggested itself in which an investigation might be made into a possible technique which would aim not at a comprehensive perspective of general science as a specialized field but rather a training in a type of insight into the subject, which insight would be of practical value in life. It was further felt that a more skilful treatment of the influence of science on human affairs could be profitably

introduced into science courses. The problem resolved itself into a scientific and experimental attack on the psychological presentation of general science as opposed to the development of the subject on the basis of adult and of logical organization, so common in modern programmes.

2. Limiting the problem.- It was soon realized that the problem set for investigation did not permit of easy solution because of many uncontrollable variables. Furthermore the field of general science teaching in Alberta and in our Dominion covers a wide range of classroom conditions, a wide variety of texts in use, and a wide range of teacher interests in the subject.

For these and other reasons, it was necessary to limit the problem to a specific phase of science learning as a single and fairly constant factor, and to proceed to investigate in a reasonably narrow field in which little research had been made. It was decided to plan an investigation of guidance among correspondence students. It was soon found that the experiment was being launched into a fertile and unexplored field as far as the modernizing and humanizing of science techniques were concerned.

In this thesis, the expression "correspondence study" will include that procedure whereby a child, either at home, in a crowded school, or in a school not presenting a particular course, receives instructional assignments,

plans his periods of study without the personalized guidance of a teacher, performs the required exercises and returns his tasks to the distributing centre for comments, criticisms, and general evaluation.

The field or scope of the investigation is therefore limited to the student doing self-study at home or at school. This resulted in the reduction of the area of possible experimentation considerably, from a complete province wide zone to certain typical "spots" which were for one reason or another isolated from teacher direction.

3. Importance of the problem: - The problem under investigation is one of considerable importance in the light of the educational experimentalism being conducted in our province today. Traditional concepts and aims of science teaching must be cast aside and a spirit of open-mindedness prevail in the approach to the problem of guidance of learning. As Noll states:[1]

> "Science teachers must think in terms of function rather than subject matter. All of which demands a careful re-statement of our aims in teaching science".

The aims of science teaching as set out by Noll typify a new point of view. Skills, habits, knowledges, attitudes, appreciations, wise use of leisure time, are items which must be kept in mind in the design or plan of a programme, if the modern goals of educational endeavor are to be achieved.

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1. The teaching of Science in Elementary and Secondary Schools - Noll, page 11

4. <u>The status of correspondence study in Canada.</u> - In each of the provinces of Canada which supply correspondence course facilities a generally uniform plan is followed. Lessons are prepared and issued from a central department which is under the jurisdiction of the department of education. Assignments and lesson materials are mailed to the student who in turn forwards his study activities to the correspondence center for evaluation and correction. The "unseen" correspondence director is the sole contact between the student and his subject-matter studies. The personalized attention and friendly comments, while encouraging to the student, must of necessity be limited in scope due to the even-increasing enrolment of students, who for one reason or another, take advantage of the correspondence service. The result is marked formalism which makes courses appear cold and barren and in many instances, the inspiration which might come from the "unseen" tutorial guide, is often completely absent. This thesis will suggest ways to improve the relationship, practical as well as psychological, between the student and the correspondence instructor.

Figure 1 is an attempt to show the inter-relationship or control-channel between the lone student and the head of the department of education, which latter person is responsible for the service rendered by the correspondence division.

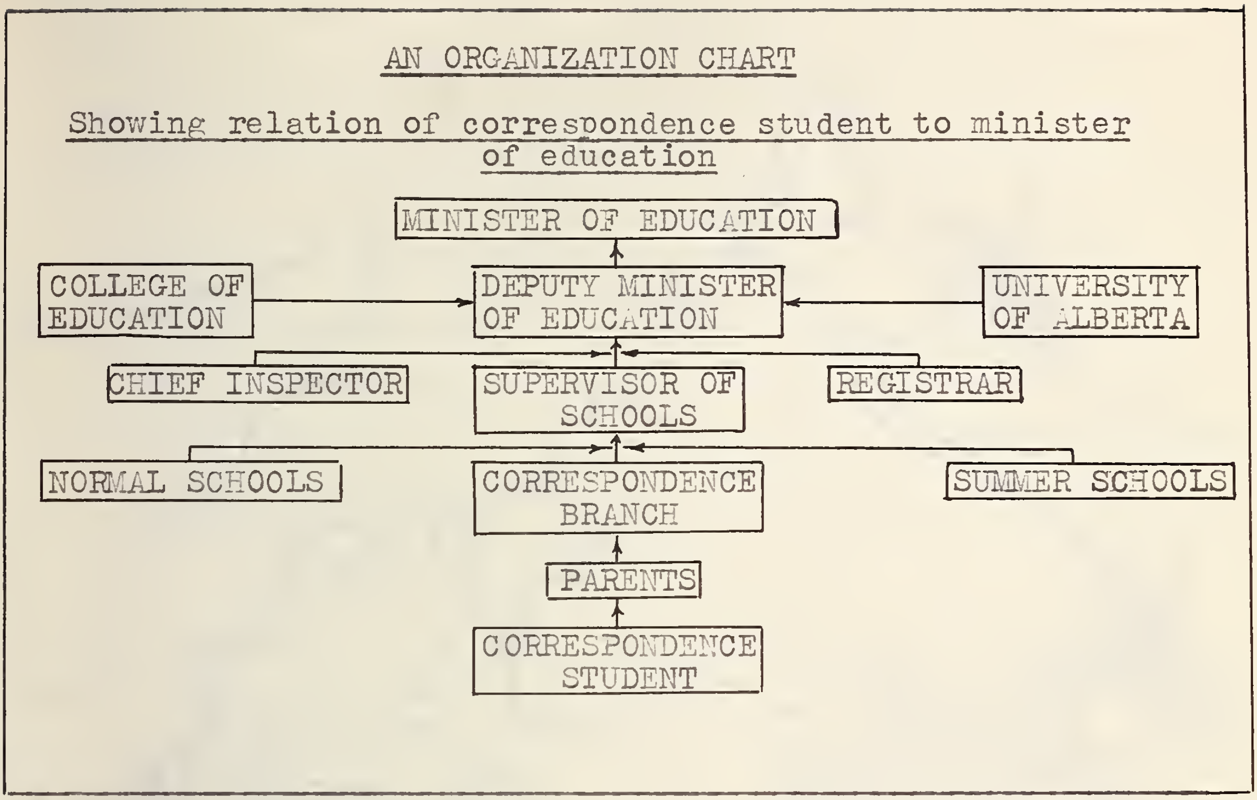
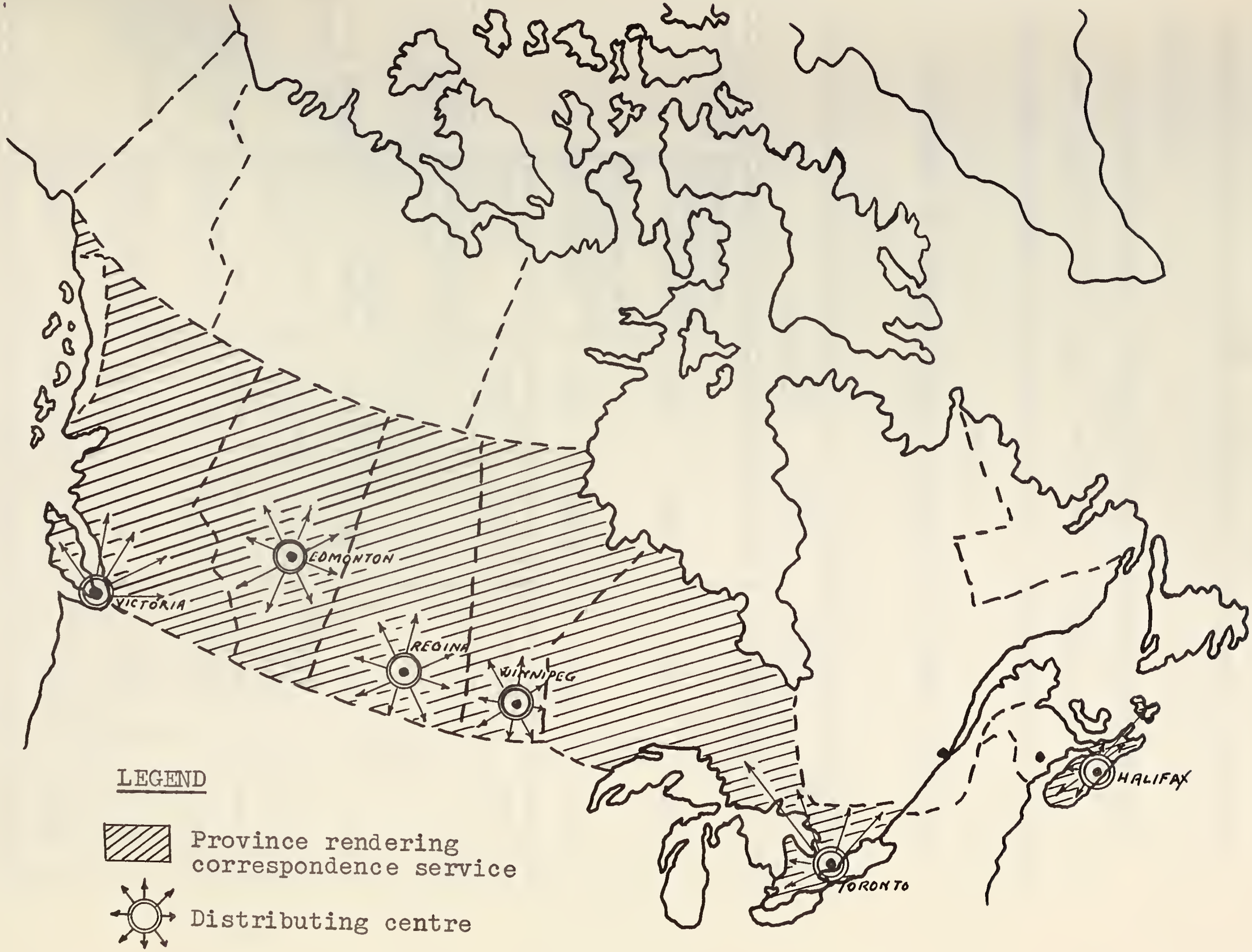


Figure 1. Plan of Alberta's educational department.

In an examination of the correspondence courses made available to Canadian boys and girls in the Dominion, it is found that the respective departments of education are taking over the service as a functional responsibility of the government of the day. No correspondence courses are provided in the provinces of Quebec, New Brunswick, and Prince Edward Island. New Brunswick is planning for the organization of correspondence work; Prince Edward Island, due to limited geographical area and therefore not faced with a problem of student isolation, has not found it necessary to introduce correspondence courses. The map shown in Figure 2 serves as a geographical resumé of correspondence services provided by the provincial centres.

Fig. 2. - GEOGRAPHICAL DISTRIBUTION OF CORRESPONDENCE INSTRUCTION IN CANADA



In all courses the value to the student is the development of a feeling of self-reliance which is unfortunately counteracted by the lack of group socialization in student activities.

The enrolments of students in correspondence courses in four Canadian provinces are shown in <u>Table</u> I . Enrolment data was furnished by the correspondence division.

TABLE I

ENROLMENT OF CORRESPONDENCE STUDENTS IN FOUR CANADIAN PROVINCES

		B.C. 1938-39	ALTA. 1939-40	MAN. 1938-39	ONT. 1939-40
ENROLMENT	Elementary grades from 1 to Vlll	1101	661	266	2126
	High School grades from lX to Xll	3101	2600	1908	176
	Total	4202	3261	2174	2302
ENROLMENT PER 1000 POPULATION	Elementary grades	1.47	.85	.37	.57
1937 Estimate Can. Yr. Bk.	High School grades	4.13	3.34	2.66	.05
	Total	5.60	4.19	3.03	.62
ENROLMENT PER 1000 SQ.Mi., of PROVINCE AREA	Elementary grades	3.06	2.66	1.21	5.82
	High School grades	8.64	10.48	8.68	.48
	Total	11.70	13.14	9.89	6.30

It is interesting to note that the 'newer' provinces to the west with their large uninhabited areas or regions of sparse population are rendering a more extensive educational service in the correspondence field than are the 'older' eastern provinces of our Dominion. The need in Alberta is characteristically in evidence especially in High School grades.

A graphical representation of the elementary and high school students enrolled in four of our Canadian provinces is shown in Figure 3.

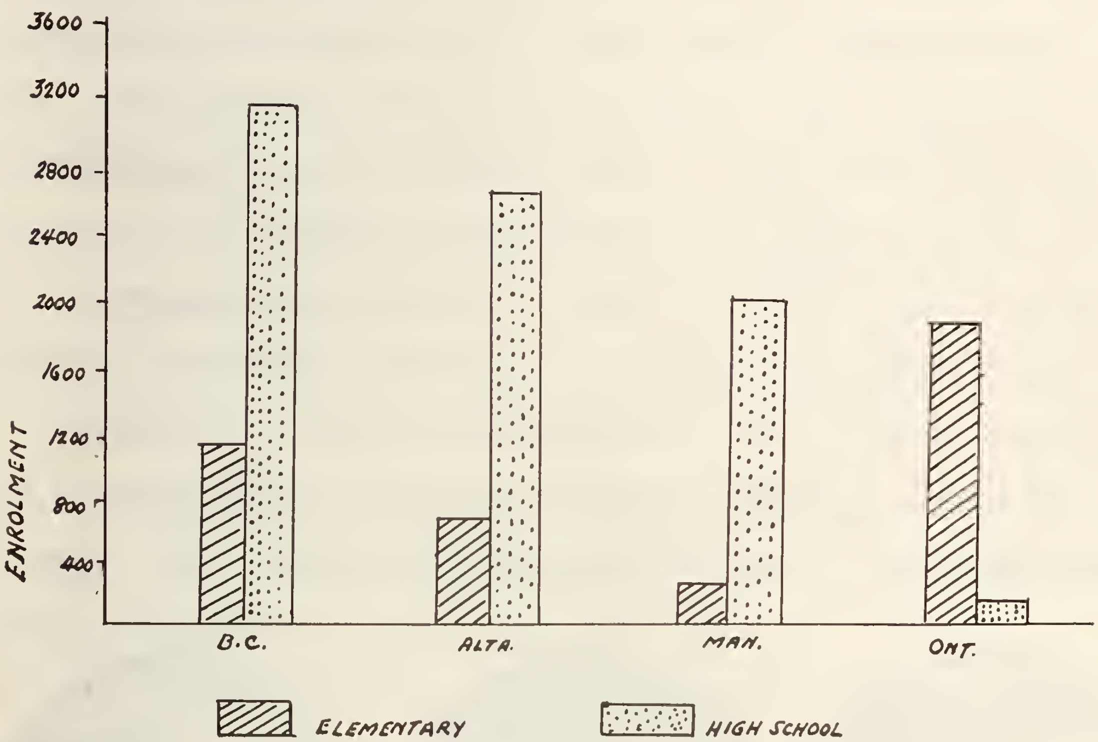


Figure 3. - Student enrolment in correspondence courses in four Canadian provinces.) B.C.- Man 1938 to 1939) Alta.-Ont 1939 to 1940

The supervision work at the correspondence centre is recognized as an essential feature in all Canadian programmes. Of necessity, because of limited funds and hence of limited

staff, the assignments are rather formal in order to facilitate the mass correction of exercises. The objective test has been introduced in some of the courses but this type of measuring device gives the test-marker little understanding of student attitudes, of ability to do careful critical thinking, or to organize his knowledge in a systematic way. With limited instructional staff, the objective type of test innovation will solve the problem of rapid measurement of student ability to 'fill-in gaps' but will tend to make the learning and testing process more frigid or inanimate and therefore less productive of proper learning attitudes, unless the guidance work is considerably more humanized and personalized than at present exists. Much experimentation is needed to discover the most suitable <u>type</u> of course for the correspondence student in order to offset the lack of teacher inspiration common to the normal classroom situation.

Figure 4 shows the distribution of costs of operating the correspondence service in British Columbia, Manitoba and Ontario. The information was supplied by the correspondence centre.

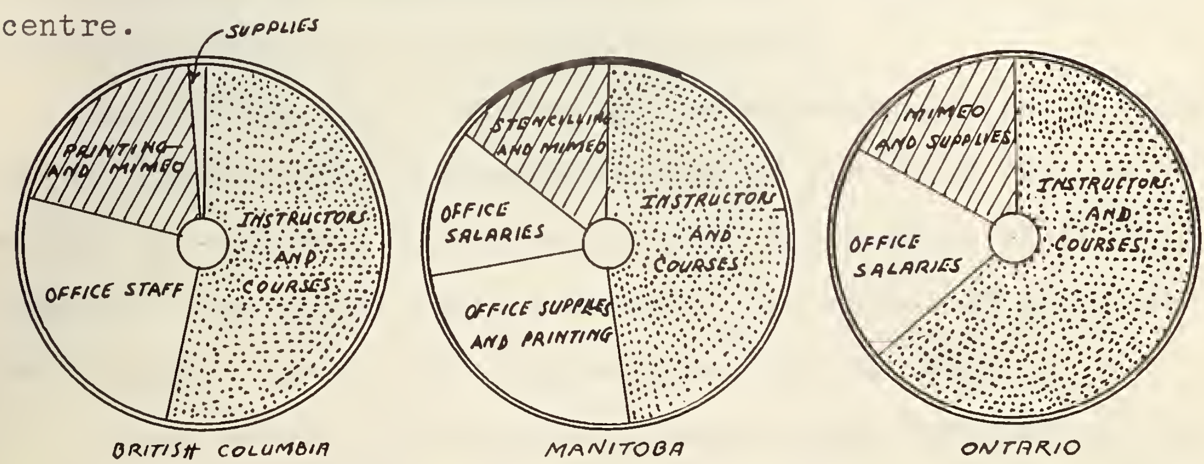


Figure 4.- DISTRIBUTION OF OPERATING COSTS OF CORRESPONDENCE COURSES IN BRITISH COLUMBIA, MANITOBA, AND ONTARIO.

CHAPTER II

PURPOSE OF THE INVESTIGATION

1. A problem demanding solution.- Our preliminary survey on the nature of the investigation in Chapter I indicates that a basic consideration of correspondence course makers is the need for humanizing the content of the lesson materials. The complete removal of the student from the social contacts of school-group living, the conditions of rugged individualism, the cold barren text book without the contribution of a teacher-on-the-spot, and a formalized set of routine lessons may discourage and even militate against the requisite mental and physical growth of the child. It is contended that the staff of the correspondence division must represent more than 'reachers-for-pigeon-holed-lessons, and tickers-off' of lesson assignments. Due to the rapid increase in popularity of the correspondence service in those provinces of Canada with rugged topography and extensive geographical area, departments of education must be prepared to employ an increased and competent instructional staff whose subject interests are diversified and who appreciate the whole pattern amd gamut of educational psychology relative to the isolated learner.

This thesis aims to investigate the possibilities of vivifying and illuminating the guidance work of the child 'out there' so that he will derive inspiration from the subject of science, a subject that should never descend to the depths of abstraction and drudgery. Such is the problem demanding solution.

In the course of the study an attempt has been made to indicate a possible technique of instruction in the field of

general science of grade nine, with special reference to correspondence students, but a technique equally suitable and adapted to the learning process of all students who are engaged in the assimilation and appreciation of intermediate school science. Stated specifically, it is the aim of this thesis to investigate, and to substantiate by experimentation, the pragmatic and gestaltic approach to the teaching of science as a possible method to be employed in correspondence school methods.

The aim of the study may be subdivided as follows:

(1) To discover by contrast, the effects on control[1] groups of the gestaltic method of "whole-presentation" as opposed to the logical subject-matter organization plan.

(2) To investigate concomitantly the value of the scientific method to the student, as it affects his attack on a problem, on his studies, on his activities in general, and on the specific performance of experimental work with laboratory apparatus.

(3) To investigate the status of correspondence course instruction in Canada and to suggest ways to improve the technique of instruction. A preliminary treatment of this phase of the study has been taken in Chapter I.

(4) To attempt to discover the effects of the gestaltic method or technique as applied to a content subject on the resultant skills, knowledge, attitudes, appreciations, in the field of general science.

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1. In this experimental study, the term "control group" shall refer to students released from regular learning situations and placed under my personal control or guidance. "Non-control group" shall refer to students not pursuing the special method of the experiment.

2. Gestaltism. - It is the contention of this thesis THAT CHILDREN LEARN BEST BY PATTERN WHOLES, which wholes must be perceived before the part. This is contrary to the customary organization of texts and of course outlines which start with the piecemeal treatment of minor small units with the hope of adding these units together to form the whole. From years of teaching experience it would appear that due to a vast loss of knowledge content, and a lack of residual understandings and generalizations on the part of young boys and girls, a new direction is necessary in the presentation of general science. This thesis sets out to discover clues for the lack of understanding common to the logical outline method of science teaching of the past, with a view to possible remedy.

Because of the importance of viewing 'wholes-as-such' before an analysis of the parts can be made, the experiment has been conducted in such a way as to test the mental and physical reactions to pre-established and organized studies of wholes related specifically to the environment of the correspondence student. The aim has been to set a learning pattern and to test subsequently for its validity. As Kandel states:[1]

> "Learning is (to the gestaltists) the breaking up of complex wholes into simpler parts, for the whole determines the properties of its parts, and a clear picture of the whole gives color to the study of its part".

---

1. Conflicting Theories of Education - Kandel, p.11.

In harmony with Kandel's evaluation of gestaltism an endeavor was made to have the child react to general science by way of 'appreciation-wholes' and not through the drill-and-logical-procedure method of routine development. Considerable care was exercised to establish the whole-concept with a reasonably high degree of clarity, these whole-patterns being of original design. It is not held that the wholes as formulated are of the best. Since no gestaltic patterns were available to the writer for possible test purposes it was necessary to proceed in a strictly experimental manner. The material planned was therefore on trial. It is possible that the design may provide a lead to text writers who might be inspired to display their imagination in the preparation of original 'whole-patterns' of photographic or artistic creation.

Kandel argues that the gestaltists only reverse the learning procedure as outlined by the mechanist psychologist. If so, then this thesis undertakes to show that this reversal is as tenable, if not more so, in establishing understandings and attitudes as is the mechanist learning procedure.

It is held that the gestaltic principle if carefully developed as a technique of instruction is beyond the realm of speculation. An endeavor has been made to organize a pattern which will offer a challenge to course designers not only in correspondence departments but in all departments of the elementary, intermediate, and high school programmes. The technique suggested should stand the tests of purpose, interests, understandings, and appreciations.

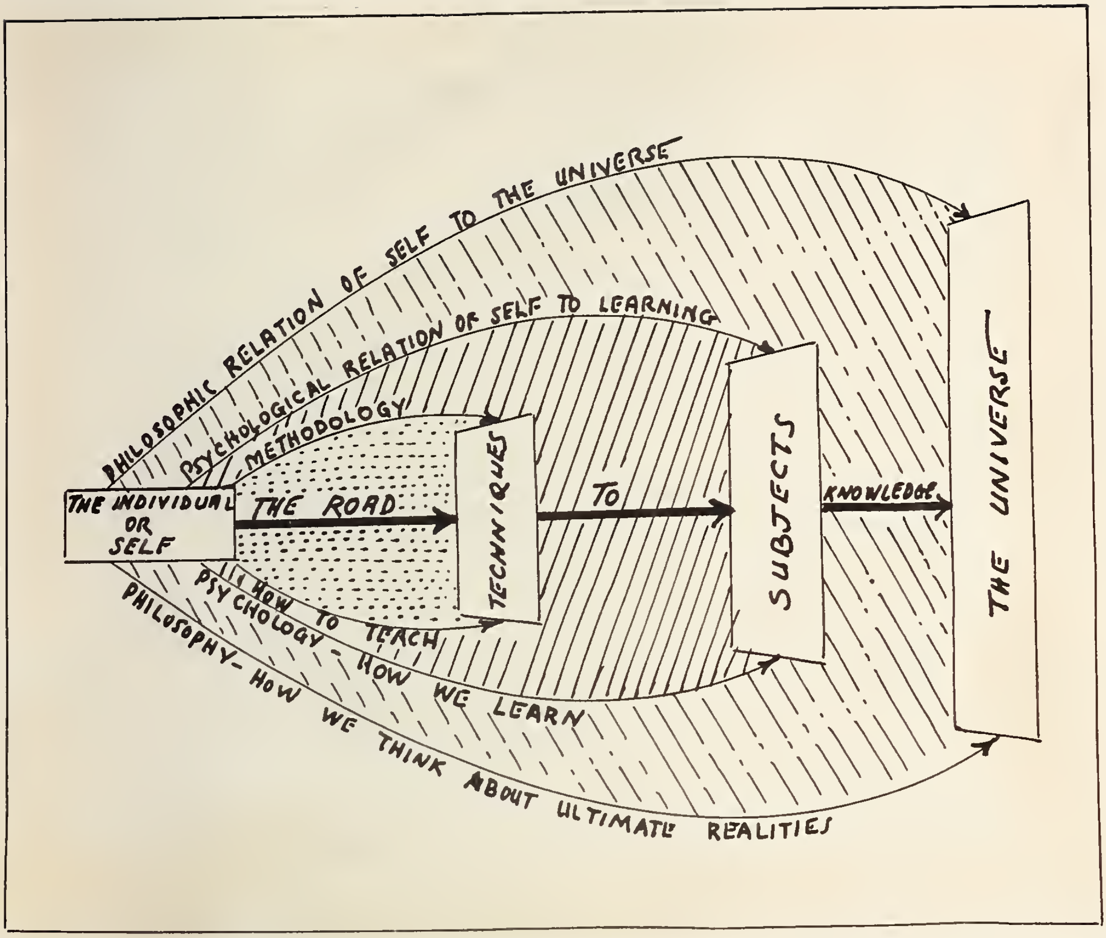

Fig. 5. - The totality of self in relation to a philosophy of education and a theory of psychology.

Figure 5 is an attempt to illustrate diagrammatically the concept of totalities of which the individual forms an integrated part. The figure should indicate to the reader that gestaltism is a tri-partite unity of (1) a philosophy of education, (2) a psychological treatment of educational method in the light of such philosophy, and (3) the relation of the individual to numbers (1) and (2).

> "The one conclusion that seems to be clear is the close relationship between philosophy of education, psychology, and methods of instruction".[1]

1. Conflicting Theories of Education - Kandel. p.115.

CHAPTER III

ORGANIZATION OF MATERIALS FOR THE CONDUCT OF THE STUDY

This chapter deals with the process of gathering and organizing the experimental materials, and the selection of personnel for the control groups.

1. Organization of the experimental groups. -

The practical set-up of the experiment is illustrated in Figure 6. The diagram if examined carefully indicates clearly the machinery for the investigation. The control students were segregated into four categories.

Group A: eight members of varied sex, nationality, age, and I.Q., selected from the Normal Practice School in Calgary, and typifying the city student.

Group B: eight members of varied sex, nationality, age and I.Q., selected from the town of Killam, and typifying the town student.

Group C: three members of varied sex, and age, registered at a school under teacher guidance, but also registered in general science with the correspondence division in Edmonton. These students may have received a slight amount of teacher guidance. This group were of the 'part-isolated' type.

Group D: six members of varied sex and age, registered in general science with the correspondence division in Edmonton. These students typified the 'lone or isolated' correspondence student.

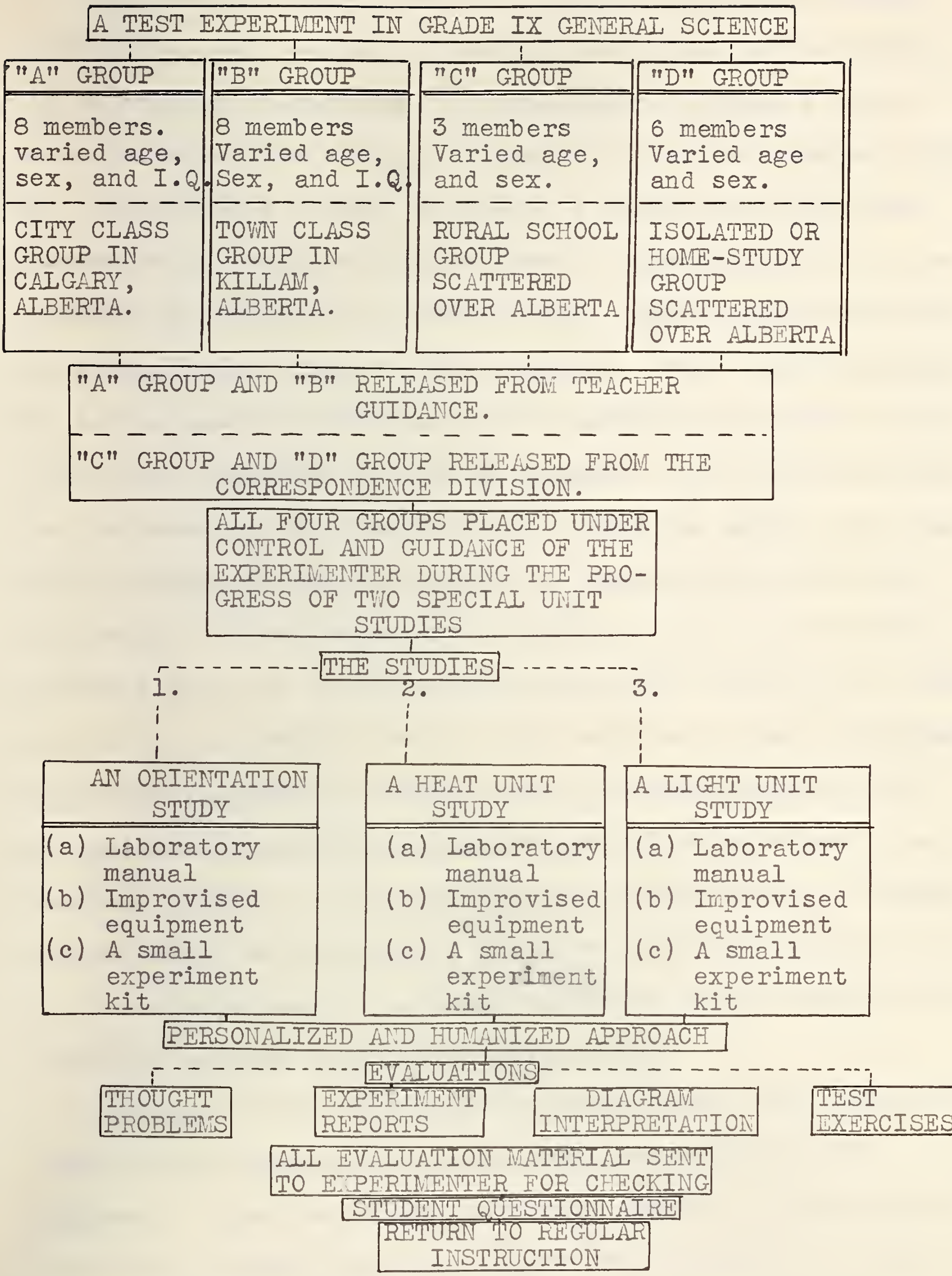

Figure--6.--Practical set up of the experiment.

The aim has been to select typical groups from varied localities, but the individuals in each group differ greatly in ability, experience, and attitudes. Groups A and B were released from classes during their regular science periods and were allowed to work or study in isolation at selected places in the building with a view to approximating the lone student who receives no teacher help. These groups received no guidance from their regular teacher. They were encouraged to set up home laboratories and to conduct experiments using improvised equipment as much as possible. The responsibility for the mastery and understanding of the two sample units was left entirely to the individual and represented a definite challenge. It was necessary to guarantee that the released students would in no way suffer during the course of the control work since the student members are required to meet departmental standards in general science during the June examinations. As explained heretofore, guidance groups are referred to as "control groups". The students were as much under my control and direction as is possible for correspondence students to be. The term is convenient although "guidance groups" might be interpreted as more appropriate terminology.

Groups C and D, the correspondence types, were granted release by the director of the correspondence division in Edmonton. These two groups were more typical of the isolated individual who must perforce assume responsibility for the solution of tasks, and see little or nothing of a guiding teacher. Such members are faced with the problem of having to

continue with a problem even though its solution is difficult. Sustained effort, self-reliance, ability to follow instructions, to concentrate on a problem, the ability to study,were some of the habits expected of the isolated student.

2. Geographical distribution of the control groups. -

Figure 7 shows the geographical distribution of the four control groups. An effort was made to procure students who in addition to being isolated in study were also far removed from cities, towns or regions of concentrated population.

The control groups total twenty-five students scattered over parkland, prairie, and mountain regions of the province. The city and town students of groups "A" and "B" total sixteen, leaving nine 'spots' for lone student activity. Only eight of the latter locations are shown on the map since two students reside in an identical community. The geographical distribution of the test groups is summed up in Table II.

TABLE II

PROVINCIAL LOCATIONS OF CONTROL MEMBERS

ALBERTA LOCATION	RELEASE GIVEN FROM	NUMBER OF STUDENTS
City of Calgary	Normal Practice School	8
Town of Killam	Intermediate School	8
Beaver Mines P.O.	Correspondence Division	1
Didsbury P.O.	do	1
Innisfree P.O.	do	1
Islay P.O.	do	1
Knob Hill P.O.	do	1
Olds P.O.	do	1
Withron P.O.	do	1
Water Valley P.O.	do	1
TOTAL IN CONTROL GROUP ---------------------------------25		

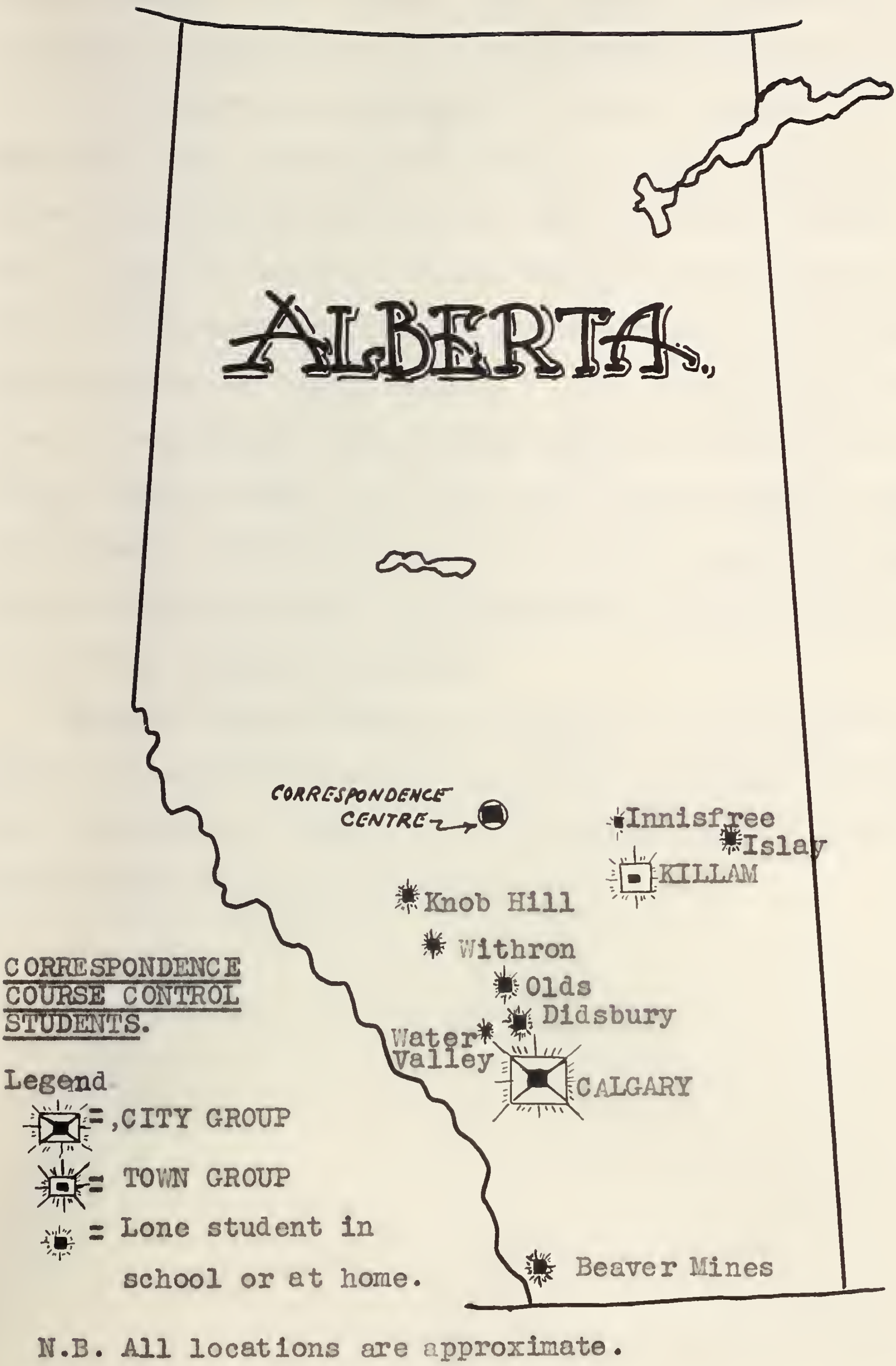

Figure 7 .- Geographical distribution of control students.

3. <u>Selection of students.</u> - In the selection of the"A" and "B" group students from city and town request was made for as much variation as possible in age, nationality, and sex representation, in order to give the technique of 'wholes' as severe a test as possible. The intelligence quotients of the city and town students were obtained directly from the school records.
For "C" and "D" Groups a random selection was made by the director of the correspondence division without any knowledge of their ability to 'carry through'. All in all, it was definitely aimed to experiment with a group varying in ability and interests, rather than to select an ideal group from the upper ranges of intelligence. For this reason it is felt that the findings of the experiment are more significant and valuable in the light of the wide range of variables.

<u>Table</u> III gives summary information on the selected students. The table indicates a range in age from 13 years 0 months to 16 years 11 months, a range in I.Q., from 86 to 131, and an even distribution of boys and girls.

TABLE III

SELECTION OF MEMBERS OF CONTROL GROUPS

No.	INITIALS OF STUDENT	SCHOOL OR P.O.	C.A. at Sept. 1-39 (yrs.mos)	I.Q.	SEX
1.	B., I.	Normal Practice	14-2	95	Girl
2.	H., E.	do.	14-5	114	Girl
3.	K., B.	do.	13-9	131	Boy
4.	M., G.	do.	14-5	107	Girl
5.	M., R.	do.	14-5	124	Girl
6.	P., P.	do.	13-0	129	Boy
7.	R., R.	do.	15-8	92	Boy
8.	S., A.	do.	13-10	113	Boy
9.	B., S.	Killam	14-0	113	Girl
1o.	E., F.	do.	15-8	86	Girl
11.	F., M.	do.	15-10	95	Boy
12.	L., E.	do.	14-3	--	Girl
13.	R., E.	do.	15-5	101	Girl
14.	Sc.,E.	do.	15-0	114	Boy
15.	Si.,E.	do.	14-6	94	Boy
16.	St.,L.	do.	15-8	96	Boy
17.	B., P.	Beaver Mines	14-8	--	Girl
18.	B., F.	Withron	15-10	--	Girl
19.	Ca.,K.	Knob Hill	13-7	--	Boy
20.	Ch.,E.	Knob Hill	13-10	--	Girl
21.	Cl.,D.	Innisfree	16-11	--	Girl
22.	D., J.	Didsbury	14-11	--	Girl
23.	E., M.	Olds	13-8	--	Girl
24.	G., C.	Islay	15-9	--	Boy
25.	S., V.	Water Valley	----	--	Boy

4. <u>Preparation of manuals, guides, tests, and experimental Materials</u>. - Since I found no correspondence course, text, or available study which followed the gestaltic or insight method of psychological learning, and whereas I desired to avoid the drill (conditioning) or frill (extreme activity) methods, it was necessary to proceed from a completely original organization.

I therefore set out to frame my own guidance material for the direction of the student.

The preparation of this guidance material took considerable time and effort. It was necessary to do my own sketch work the standard of which is scientific and analytical rather than artistic or representative. The general pattern of the organization of study materials is shown in Figure 8.

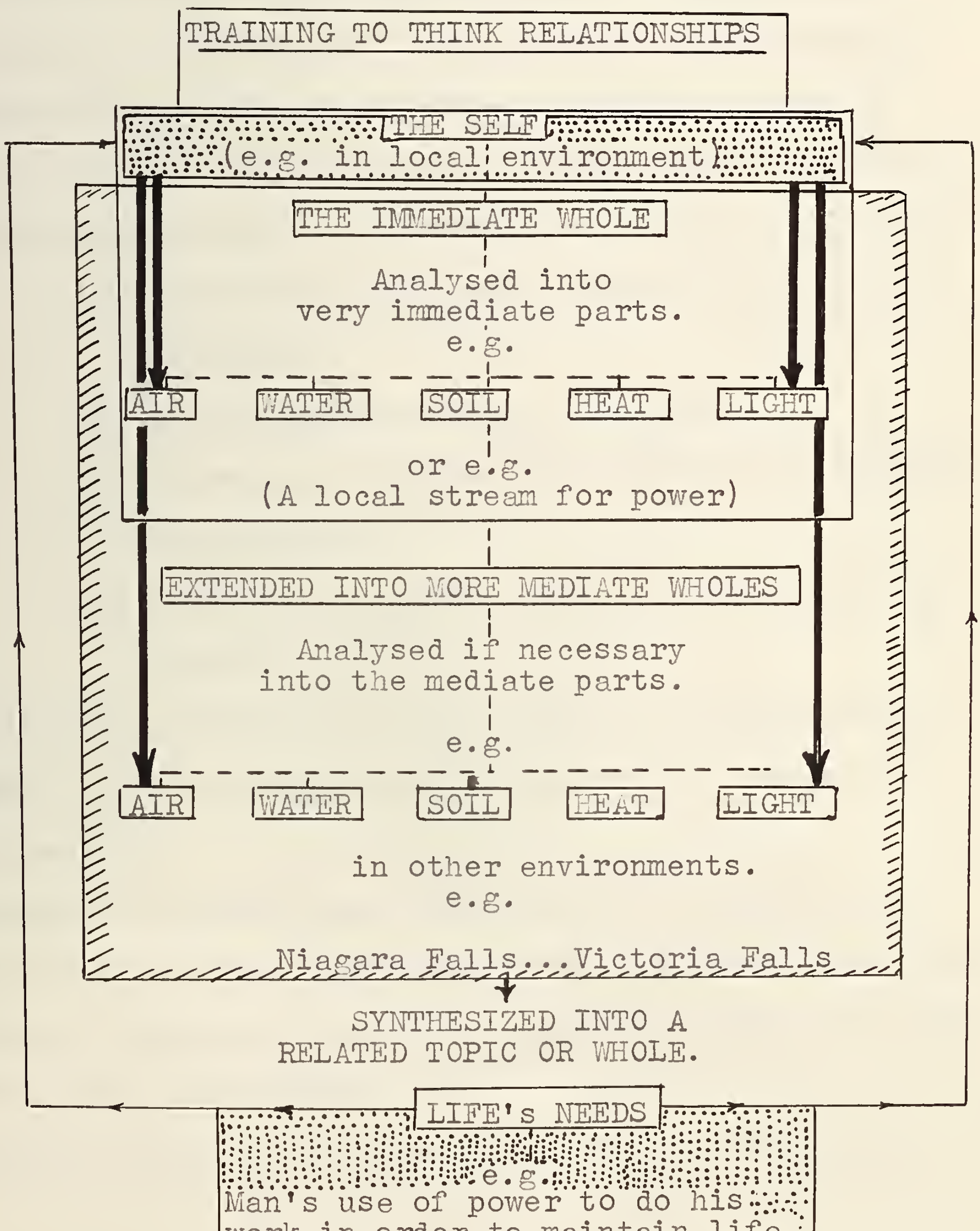

Figure 8. - The pattern of gestaltic studies prepared for the experimentation work.

Complete and explicit directions were furnished the student so as to fit the special studies into his regular programme.

The content of the manuals and guides utilized the following design principles:

(1) direction into the gestaltic appreciation both in the introduction and at the conclusion to the study.

(2) relationships established between the experimental activities and the world-wholes under consideration.

(3) motivation of the study through careful arousal of interest and the formation of proper mental attitudes.

(4) environmentalized and personalized content achieved by:

 (a) selecting local and personal illustrative material.

 (b) self-experimentation activities.

 (c) extension of ideas from immediate to mediate experiences.

 (d) creating an appreciation for the wonders of nature.

(5) initiative called for in (a) mapping out one's work, and (b) in the improvisation required in unexpected situations.

(6) problem situations requiring the use of imagination, research reading, experimentation, and local observation.

(7) laws of learning relative to interest, effect and readiness were considered.

(8) sketch studies as a recognized means of arriving at

generalizations were introduced.

(9) objective understandings and subjective impressions were evaluated.

This set of principles of design are considered to be essential and common-sense in viewpoint if the child is to be oriented to a rich appreciation of science. It is felt that the approach to science through a detailed explanation of the scientific method is not sufficiently concrete and real to the child, and for that reason such treatment of method was left until specific problems arose involving the use of data in an opportune situation.

The manuals and guides are listed in the appendix to this thesis.[1] A close scrutiny of their content will indicate that an attempt has been made to achieve such outcomes as skills, appreciations, and some knowledge. The HEAT and LIGHT studies were chosen as typical of the intermediate school programme in grade 1X, the units being sufficiently advanced in the course outline to allow for students who were somewhat retarded in the scope covered at the time of the investigation. The keynote to the two studies is the spirit of 'getting right down to earth', to the child's earth, as opposed to the approach through techniques and avenues of the laboratory research worker.

The following list of materials was sent to each of the twenty-five students:

(a) hektographed copy of the preliminary orientation.[2]

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1. See appendix 1 to 10.
2. See appendix 1.

(b) preliminary guide manual of instructions. This manual treats of experiment materials, techniques in handling equipment, improvisation of apparatus, and the setting up of an experiment corner at home.[1]

(c) hektographed copy of the HEAT study, specially prepared in the light of the gestaltic method.[2]

(d) an accompanying laboratory manual on the HEAT study, to guide experimental activity, and entitled "Manual A".[3]

(e) a hektographed guidance study on the LIGHT unit specially prepared for this thesis.[4]

(f) an accompanying laboratory manual on the LIGHT study, to guide experimental activity and entitled "Manual B".[5]

(g) A small experiment kit loaned to the student and later returned to the author.[6]

(h) achievement tests on the HEAT and LIGHT units.[7]

(i) questionnaire for evaluation of the new technique.[8]

All studies were typed, illustrated, hektographed in Calgary and mailed to the individual student. Most of the instructions to the student were contained in the manuals and guides to the studies. A few supplementary directions were sent out in a special letter.

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1. See appendix 2.
2. See appendix 3.
3. See appendix 4.
4. See appendix 6.
5. See appendix 7.
6. See appendix 10.
7. See appendix 5 and 8.
8. See appendix 9.

CHAPTER lV

CONDUCTING THE EXPERIMENT WORK

1. Description of the materials. -

In dealing with the two special units on HEAT and LIGHT no attempt was made to treat of interpretations beyond the scope of these two themes. Some thought problems for pupil consumption were introduced; certain exercises for entry into student notebooks were outlined. The directional activities were to function precisely as if controlled by a correspondence centre. In addition to illustrating the new technique, the experiment was conducted in such a way as to furnish data for summary conclusions.

The plan followed in conducting the experiment, might quite appropriately be termed the "guidance-concept-test" scheme. The student experienced a type gestaltic study related to the modern changing world and to the student as an individual dwelling in the on-going flux. The graphs, sketches, illustrations, and time lines were designed in simple understandable fashion in order to impress the student in a vivid manner.

The general pattern or formula for the unit studies was as follows:

1. PREPARATION: problem awareness or purpose.
2. ORIENTATION: the gestalt, in which the problem is viewed as a totality and the extent of the study recognized.
3. MOTIVATION: arousal of thought and interest through

preliminary appreciations related to life.

4. SEPARATION: an analysis of the gestaltic whole into sub-themes or smaller wholes related to the general overview.

5. PARTICULARIZATION: graphic and visual treatment of particular details.

6. ACTIVATION: concomitant reading, experiments and exercises for notebook records.

7. SUMMATION: a summary re-view of the sub-wholes, re-integrated into the larger gestalt.

8. GENERALIZATION: the formation and statement of concepts or general ideas.

9. EVALUATION: tests of skills, appreciations, and knowledges.

2. How data was secured. - Because of the uncontrollable and intangible elements heretofore mentioned, the problem of obtaining data was not an easy one. Objective and subjective measurement were utilized in gathering the student reaction to the studies. Close contact was maintained with the four groups "A", "B", "C", "D" (see figure 6). It was apparent in the very early stages of the work that there existed a diversity of interests as between the rural and the city or town groups. The rural students, even though retarded or hampered with home and farm duties, worked more faithfully and thoroughly than did the town students in group "B". The "A" group in Calgary showed reasonably good effort, keen interest, and performed efficiently according to their individual abilities.

It should be recalled that the "A" and "B" groups in town and city were encouraged to work as if they were 'lone' students of the correspondence type, conducting their activities on the self-study plan of direct experience. Students were left to display their own initiative and resource in improvising equipment and in building a laboratory set-up. The city and town groups were not easily motivated into this artificial situation and for this reason some of the students had to expend considerable effort in their pretended experience.

Judgment of achievement was based on the tests furnished the students. The correspondence students were advised to be honest with themselves and to answer the tests without reference to outlines, manuals, or texts. Town and city students in groups "A" and "B" wrote the tests on the two units under the supervision of their regular room teacher.

All students in the grade lX Normal Practice room totalling thirty three members, and all students in grade lX of the Killam school wrote the tests prepared for this thesis. Both control and non-control results are tabulated in Chapter V . Furthermore, these full classes, representing control and non-control groups, wrote tests on two units as prepared by the regular room teacher. These latter tests were based on the routine presentation of science and were unrelated to the special studies prepared for this major experiment. All tests were sent to me for correction and subsequently returned to the room teacher for verification with the students.

Questionnaire data was received from the following sources:

(1) students in the control groups, (2) from the two teachers who released students in groups "A" and "B", and (3) from superintendents of rural divisions in Alberta. I feel that the opinions of the latter group, because of their close contact with the rural situation approximating the correspondence pattern, should be of special merit.

3. Distribution of materials. - To obtain a typical evaluation of the experiment the twenty-five sets of printed materials, supplies, and accompanying letters, were mailed out and comments and suggestions called for from the students. The result was that after slight revisions, the final form of the studies was arrived at.[1]

Materials were sent to the student sequentially with a reasonable time interval between the mailings. A full unit was sent at each mailing.

Students were left to themselves in the planning of study and in the amount of time to devote to each unit. A suggested time for the completion of the studies was given in the guide manuals. Notebook instructions and standard form for writing out experiments were proposed to the students.

4. Guidance in the use of experiment kits, improvising a laboratory, etc. - All students in groups "A", "B", "C", and "D" were encouraged to set up a home laboratory for experimentation. With the exception of the "B" group in Killam the remaining sixteen students were sent small experiment kits.

1. See appendix to this thesis. (Numbers 1 to 10)

The content of the kit comprised the following:[1]

One florence flask	250 cc.
One beaker	150 cc.
One bottle of alcohol	40 cc.
One bottle of limewater	40 cc.
One piece rubber tubing	12 inch length.
One piece glass tubing	12 inch length.
One 2-holed rubber stopped	#4
One 1-holed rubber stopped	#4
One test tube.	
Two filter papers with instructions on how to fold.	
One candle.	
One labelled ointment tin of potassium chlorate.	
One labelled ointment tin of powdered sulphur.	
One labelled ointment tin of slaked lime.	

The students were advised to equip their laboratory with the following supplementary materials, mostly improvised.

Alcohol lamp
Bags, paper
Balloon
Blow-pipe
Bottles
Burning glass
Cans
Cells, dry (used)
Coin
Coal
Corks
Curtain rod (old)
File
Gauze, wire
Hammer
Labels (gummed)
Matches
Nails
Needles
Rod, iron
Sawdust
Screws
String
Support stand
Tape
Test tube clamp
Test tube rack
Water (distilled)
Wick, lamp

Instructions for improvising equipment and for building the home laboratory were given in the preliminary guide manual.[2] The Killam group being so far removed from the control centre utilized improvised equipment and simple apparatus provided by the room teacher.

The manuals of instruction gave specific instruction as to

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1. See appendix 10.
2. See appendix 2.

method and time of performing experiments in order to correlate with the study in hand. All experiments were related to actual life situations and the students advised to do follow-up readings from their texts.

The students were given about three months to complete the unit studies. The Calgary group ("A") finished in two months whereas the Killam group ("B"), the individual students in schools, and the isolated students, took longer than two months. The delay in completion on the part of groups "B", and "C", and "D" caused some inconvenience in getting the complete data into final shape for submission.

Figure 9 is a photograph of a home laboratory constructed by student H.E. a young lady age 14 yr. 6 mo., of Group "A".

Figure 10 is a photograph of control group "A" from the grade lX of the Normal Practice School in Calgary. This group is seen standing in front of five improvised laboratory set-ups. Two layouts are shown on the table in the foreground.

Figure 11 is a photograph of the improvised laboratory set-ups of members of the Calgary Control group.

Figure 9.- A home laboratory made by H.,E.,girl, of Group "A" in Calgary; age 14 yr. 6 mo.

Figure 10.- Control group "A" of the Grade IX Normal Practice School, Calgary, Alberta.

Figure 11.- Improvised laboratory set-ups prepared by the "A" control group from Calgary,Alberta.

CHAPTER V

RESULTS AND INTERPRETATION OF THE PROBLEM UNDER INVESTIGATION

Certain general and specific conclusions to the problem became evident as the reports and exercise materials were sent in for evaluation.

From the results of the questionnaire[1] sent in by the students of the control groups it was repeatedly observed that to the individual who accepted the problem-solving challenge, the gestaltic method of 'learning-by-insight' was of definite value. The resourceful student clearly benefitted from his newly tried experience of whole-to-part learning, even though the individual member had difficulty in expressing his appreciation for the technique in psychological terms. The language of the responses suggested the term 'insight', indicating that an integration of ideas prevailed throughout the study. It would appear therefore that the student 'caught on' and had succeeded in recognizing 'gestalten'. So well had they established mental learning patterns that in the case of every student, dull or bright, the first unit on <u>HEAT</u> was completely understood. Chapter Vl will indicate the readiness with which the control students 'took to' the second unit on <u>LIGHT</u>, after having received training in the first unit on <u>HEAT</u>. It might well be concluded at this stage that the pattern method of learning was psychologically effective.

Certain members of one control group, whose attitude to study and to school work in general, as disclosed by the room teacher was unsatisfactory, did not master the gestalt technique

1. See appendix 9

because they did not 'take hold'. Whereas in the normal course of events the room teacher conducts the formal process of teaching and explaining, it was apparently just too much effort for this control group to 'work for themselves'. Their case histories, when correlated with the questionnaire and test results, substantiate the view that a lack of interest in the special study and an adverse attitude to school work prevailed.

The purpose of the questionnaire was to discover (1) individual attitudes toward the studies, and (2) appreciations for the new method to which they had been introduced. In the case of the isolated correspondence students, these intangible elements are practically impossible of measurement since the individual does not come under direct teacher observation. Through the medium of the questionnaire an attempt was made to discover (1) whether or not the students had benefitted from the studies, and (2) if they wished to proceed with a second unit of similar type to the first, and (3) if they were adapting themselves (catching on) to the new technique.

1. Summary of questionnaires. -

Table IV presents a summation of those questionnaire items of greatest significance. These results were obtained from the specific responses of the individual students. The table is divided into three parts according to the control bodies, groups "C" and "D" being combined since they are jointly representative of the isolated student. The opinions, 'highly favorable', 'favorable', and 'unfavorable' are based on views expressed in paragraph or statement form in the questionnaire.

TABLE IV

QUESTIONNAIRE SUMMARY: Attitudes and appreciations displayed in the attack on the gestaltic method of presentation. (18 reports)

No. of questionnaire item[1]	GROUP "A" (7 reports) Normal School, Calgary, Alberta			GROUP "B" (5 reports) Town School, Killam, Alberta			GROUPS "C" & "D" (6 reports) Isolated students			TOTALS All groups.		
	Very favorable or favorable	Not favorable	Total	Very favorable or favorable	Not favorable	Total	Very favorable or favorable	Not favorable	Total	Very favorable or favorable	Not favorable	Total
1	7	-	7	3	2	5	6	-	6	16	2	18
2	7	-	7	3	2	5	6	-	6	16	2	18
3	7	-	7	4	1	5	6	-	6	17	1	18
4	7	-	7	2	2	5	6	-	6	16	2	18
5	7	-	7	3	2	5	6	-	6	16	2	18
6	6	1	7	3	2	5	6	-	6	15	3	18
7	6	1	7	4	1	5	6	-	6	16	2	18
8	7	-	7	4	1	5	6	-	6	17	1	18
9	7	-	7	3	2	5	6	-	6	16	2	18
10	6	1	7	0	5	5	6	-	6	12	6	18
13	7	-	7	4	1	5	6	-	6	17	1	18
14	7	-	7	3	2	5	6	-	6	16	2	18
15(a)	7	-	7	3	2	5	6	-	6	16	2	18
16	7	-	7	2	3	5	6	-	6	15	3	18
17	7	-	7	2	3	5	6	-	6	15	3	18
Total cases	102	3	105	44	31	75	90	0	90	236	34	270
Per cent	97%	3%	100%	59%	41%	100%	100%	-	100%	87%	13%	100%

1. See appendix

The data in table IV indicates that, apart from the "B" group from the town of Killam, the general attitude to the study work was very favorable. Because of the necessity of including the information from this town group of eight students in the body of this report, the group will be given special treatment in chapter VI. Favorable attitude to the method as expressed by the city control group "A" totalled ninety-seven per cent; fifty-nine per cent of the town group "B" favored the plan; <u>one hundred per cent favor was expressed by the isolated student members in groups "C" and "D".</u> The table displays a striking contrast in the attitude and appreciation of the lone student who must ever exhibit resourcefulness, as compared with the "B" group from the town who were not prepared to accept responsibility in a spontaneous fashion. This latter group proved to be an unfortunate selection as will be shown in chapter VI.

<u>Resumé of data obtained from the questionnaires</u>:

Item 1: Students were favorably disposed to the method of wholes.

Item 2: The home laboratory was especially appealing to all groups.

Item 3: The laboratory manual or experimenter's guide was quite generally appreciated.

Item 4: Science appreciation in general was increased.

Item 5: In the overview plan, students found it easy to recall the work covered.

Item 6: Student opinion was divided as to the value of copying diagrams and charts. This is to be expected. An expression of the child's <u>own effort</u>

in regard to <u>his</u> achievement in the formation of general concepts is to be preferred to a superimposition of adult generalizations.

Item 8: Many students developed a new point of view in their studies.

Item 10: The method of working alone indicated that the bright student who is released is able to carry out problem-solving activities by himself. The slower student requires careful guidance under any plan of teaching.

Item 12: The students expressed themselves rather vaguely in regard to their method of arriving at science generalizations. Opinions on the psychological development of conceptual understandings are naturally difficult to describe.

2. <u>Findings of major importance.</u> -

(a) <u>The method of wholes</u>: As discovered by tests and by the questionnaire, students generally favored the gestaltic plan of instruction. The lone student appreciated what was done for him by the distributing centre, to a greater degree than did the teacher-directed student who was removed from his normal classroom situation.

(b) <u>Individual differences:</u> Because of variations in intelligence, personality, attitudes, home environment, and chronological age, the results in terms of these several variables were not totally in favor of the gestaltic plan of attack. This expectation is in accordance with our aim

viz. to make the technique a constant relative to several variables and to note observations.

(c) Correlations: There was a definite correlation between poor attitude, low intelligence, and readiness to be book-fed, note-fed, and teacher-fed, in the case of certain individuals of group "B". Case histories indicate that any method or technique involving self-discipline and self-responsibility will break down if the student does not assume an attitude of persistent effort in regard to his own learning.

(d) The home laboratory: Individualized experiment work by the student must be recognized as a prime requisite of correspondence courses.

(e) Guidance: Laboratory experimentation must be carefully guided by means of a laboratory guide manual.

(f) Science appreciation: This phase of science learning as a phase of mental development is possible to direct.

(g) Patterns: The over-view and re-view patterns assist pupils to detect relationships in science; they also assist in establishing concepts and generalizations.

(h) Student patterns: Only a limited amount of the 'gestalten' patterns should be prepared for the student. He should be encouraged to design his own summary patterns and to submit them for evaluation to the correspondence centre.

No two student patterns will be alike.

(1) Science understandings: In order to develop a higher standard of science understandings the sketch, chart, diagram, and science apparatus are essential media of learning.

(j) Generalizations: This thesis cannot deal with the manner in which students arrive at broad science generalizations. There is every indication that, if properly guided, the student endeavors to generalize. We cannot be sure however, that the major generalizations will develop automatically from the study of isolated particulars. It is the duty of course designers to see that particulars are so interrelated as to lead to a concise summation of abstract concepts relative to science principles.

(k) Order of benefit: The investigation disclosed that the control members benefitted from the experimental investigation in the following order: (1) the lone or isolated student, (2) the city control group, (3) the town control group. This was a very happy discovery since the main purpose of the thesis was to investigate the possibilities of the gestaltic method relative to correspondence work.

(l) Student notebook: There will always exist a need for examining from time to time the student notebook in science.

(m) How to study: In order that the student's time will be spent most profitably both in correspondence and non-correspondence learning situations, it is paramount to instruct students in methods of study.[1]

(n) Preliminary instructions: Instructions to the student at the beginning of a course must be simple, definite, and complete.

(o) Equipment: The correspondence centre must very carefully prepare a list of equipment, supplies, and improvised materials needed for the efficient handling of science.

(p) Texts: Correspondence courses must be related to readings,

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1. See "Educational Psychology"-Sandiford, pp. 233-235.

research, and studies in authorized texts.

(q) Reports: Students must be given specific directions relative to the writing of exercises, reports, and experiments.

(r) Techniques and skills: Students must be informed of the techniques to be followed in the preparation of science drawings, the making of chart summaries, the use of color, and the preparation of tabulations.

(s) Self-correction of errors: Students must be advised to read over all exercises before forwarding same to the correction centre in order to detect careless errors in spelling, grammar and punctuation.

(t) Persistent application: Students must be advised of the necessity of working steadily, and of planning their work in large time blocks.

(u) Self-reliance: A correspondence course organized on the gestaltic or any other line demands much independent effort and thought on the part of the learner.

(v) Student essay and written work: This phase of the course must be kept down to a minimum commensurate with efficiency.

In general it was interesting to discover that the cooperation of the isolated rural student in the experimental investigation was much superior to that of the town and city groups. The rural student followed detailed instructions completely, probably due to a felt need and to the satisfaction experienced from observed growth. The motivation of town students, artificially removed to a 'pretended isolation', which is not a part of their regular experience, presented a difficulty.

It is held that motivation of the rural correspondence student must come from the following sources: (1) encouragement given at the correspondence centre, (2) inherent interest contained in carefully designed courses, and (3) the observed growth as detected by the student himself.

3. Interpretation of the data collected. -

Group "A": City control group.

The results of tests given this group indicate that the gestaltic method of 'wholes' was at least as sound and as effective as the routinized text-book scheme of presenting isolated lessons. I was satisfied that in the light of their standing on the tests, the students did not suffer from being released from regular class work. Their individual rankings are as high in the control tests as in their regular class tests.

The test on the HEAT unit was administered to the full class including control and non-control students. This test[1] was so designed as to measure abilities in the following phases of science training: (1) interpretation of data, (2) application of principles, (3) scientific description, (4) science discrimination as measured by objective tests, (5) science processes, (6) nature of proof. The results of the HEAT unit test are analysed in table V .

The analysis reveals the following information:

(1) The ranks of the control group, consisting of members of varying abilities and attitudes, were scattered throughout the table. This is in harmony with the method of selection of control group members.

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1. See appendix 5.

TABLE V

ANALYSIS OF RESULTS OF TEST ON HEAT UNIT SHOWING RANK DISTRIBUTION OF THE FULL CLASS: NORMAL PRACTICE SCHOOL.
The table includes control group "A"

Student member	C.A. (Yrs.-mos)	I.Q. (control group)	Interpretation of data	Application of principles	Science description	Objective test discrimination	Science processes	Nature of proof	Total times 3/2 = 100
			TEST VALUES						
			(15)	(15)	(6)	(14)	(9)	(8)	100
1.M.J. boy	14-7	-	15	14	5	12	8	8	92
# 2.R.R. boy	15-8	92	9	11	3	13	9	6	77
3.H.D. boy	14-6	-	9	14	5	12	5	6	77
4.M.N. boy	14-1	-	12	15	2	10	3	8	75
5.M.R. boy	14-0	-	14	10	5	9	5	6	74
# 6.P.P. boy	13-0	129	8	10	5	9	8	8	72
7.H.J. girl	13-8	-	10	10	0	11	4	8	70
8.R.M. girl	13-8	-	9	10	0	10	8	6	65
# 9.K.B. boy	13-9	131	7	8	4	11	8	4	63
#10.M.G. girl	14-5	107	5	9	5	9	8	6	63
11.L.G. girl	16-4	-	15	13	0	10	1	2	62
12.H.J. girl	14-1	-	8	14	0	8	7	4	62
13.B.G. boy	14-0	-	8	10	0	12	8	2	60
14.D.B. girl	14-11	-	12	12	0	11	3	2	60
15.A.G. boy	18-0	-	10	12	0	10	4	3	59
#16.H.E. girl	14-5	114	5	8	6	11	2	6	57
17.L.J. boy	15-3	-	10	13	0	9	1	6	56
			Median position						
18.S.A. boy	14-6	-	7	10	0	11	1	8	56
19.R.N. boy	16-6	-	7	13	0	9	3	5	56
20.C.F. boy	14-3	-	5	13	0	10	2	6	54
#21.B.I. girl	14-2	95	6	7	0	10	9	4	54
#22.M.R. girl	14-5	124	2	11	6	11	4	1	53
23.M.B. boy	14-6	-	7	10	0	10	3	4	51
#24.S.A. boy	13-10	113	6	5	0	11	6	6	51
25.W.H. boy	14-9	-	6	12	0	9	3	4	41
			Pass line						
26.M.R. boy	14-9	-	6	11	2	10	3	0	48
27.M.E. girl	16-4	-	11	7	0	8	3	0	42
28.R.L. girl	16-10	-	5	7	0	8	2	5	41
29.G.J. girl	14-8	-	6	8	0	7	4	2	41
30.I.R. girl	16-0	-	3	9	0	11	6	0	41
31.M.J. girl	16-5	-	3	11	0	9	1	2	39
32.E.G. girl	15-7	-	3	5	0	8	1	0	26
33.G.H. girl	14-8	-	3	5	0	7	0	0	23
Median class			6.5	9.5	0	9.5	3.5	3.5	56
Median control students			6.0	8.5	4.5	10.5	7.5	5.5	60

= control students

(2) The control students did not suffer in being released from their regular class work. No member of the control group was discovered in the lowest quartile range.

(3) In certain types of scientific thinking the control group median is higher than for the whole class. In other types of scientific thinking the control members did as well as the non-control group. The control group were slightly inferior to the whole class performance in the following thought patterns: interpretation of data, and application of principles. They were decidedly superior in science description, objective test discrimination, analysis of science processes, and in nature of proof.

(4) The lowest quartile range is composed mostly of girls and includes none of the control group members.

(5) The upper quartile range is composed mostly of boys and includes two of the eight control group members.

(6) By examination of the tests, it was evident that girls are neater in diagram work and penmanship than are boys.

Figure 12 is a graphical representation of the achievement in the <u>HEAT</u> unit by the control and non-control members of the city class tested. The frequency polygon shows a rather normal distribution of abilities both for the full class group and also for the eight control students. We may conclude that the control group, with varying I.Q.'s, did as well and probably better than they would have otherwise done without the gestaltic training, in this particular test, and on the specially prepared unit. The control-group median is higher than that of the whole class.

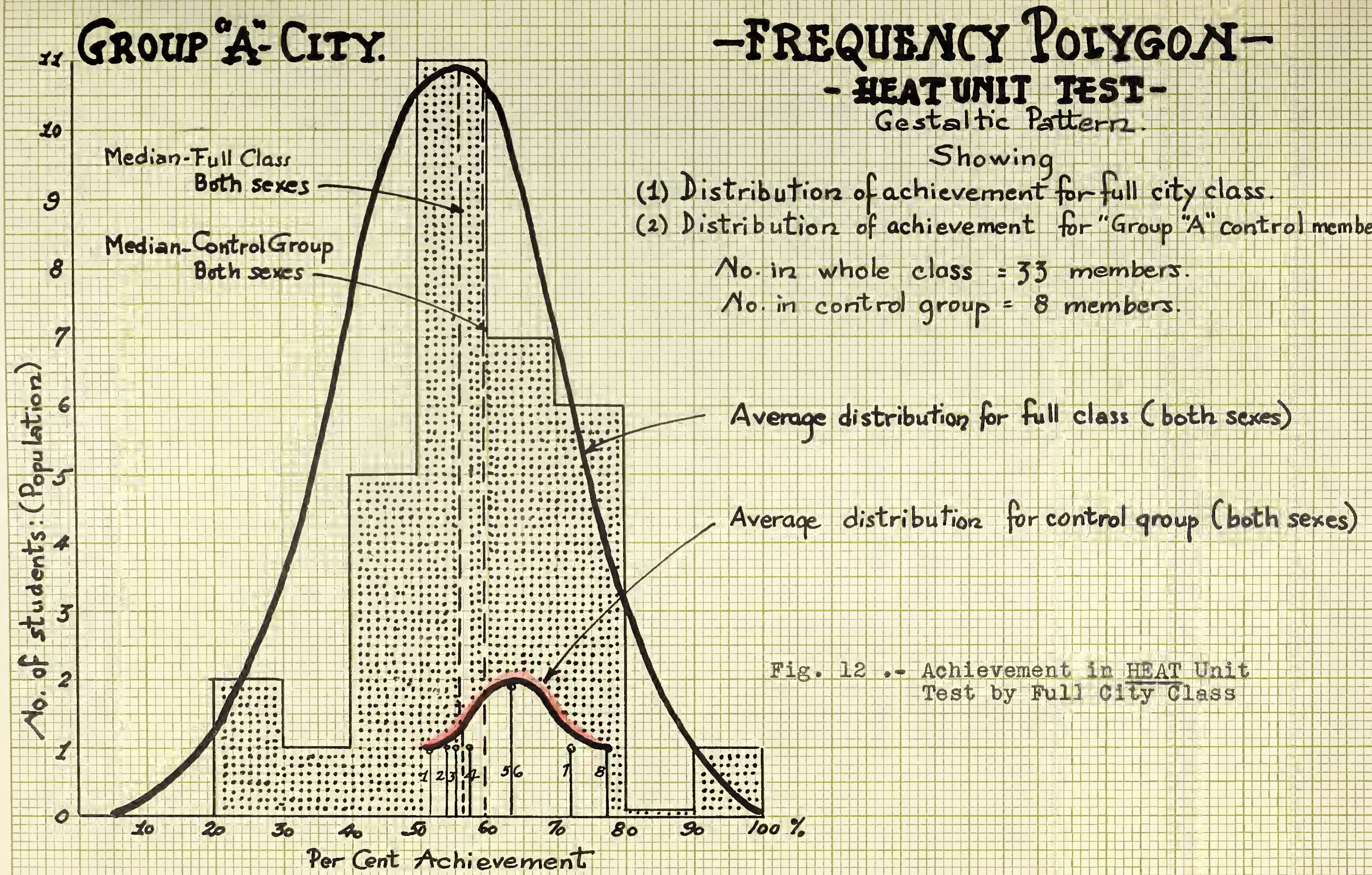


Fig. 12 .- Achievement in HEAT Unit Test by Full City Class

Figure 13 represents the sex distribution of abilities in the HEAT test for the full city class of girls and boys. We may conclude (1) that dull girls perform less well in science than dull boys, (2) that bright boys do better in science than do bright girls, and (3) that the median performance of boys in science is slightly higher than that of girls.

Figure 14 is a correlation table or graph representing the relationship between the achievement in the HEAT unit test and chronological age for the full city class. The graph shows a correlation of ($r = -.40$). In other words the bright young student does as good work as the dull older student.

Group "B": Town control group.

Table VI summarizes the relative achievement in the HEAT unit test for the town or "B" control group. This test was administered to the full class, including both control and non-control members.

GROUP "A"- CITY.

-FREQUENCY POLYGONS-
-HEAT UNIT TEST
-GESTALTIC PATTERN-
SHOWING—

DISTRIBUTION OF ABILITIES BY SEXES

NO. IN WHOLE CLASS = 33.
NO. OF BOYS = 16.
NO. OF GIRLS = 17.

MEDIAN PERFORMANCE OF BOYS SLIGHTLY HIGHER THAN FOR GIRLS.

(11 STUDENTS OVER 15 YEARS OF AGE)

LEGEND: ———— GIRLS.
- - - - - BOYS.

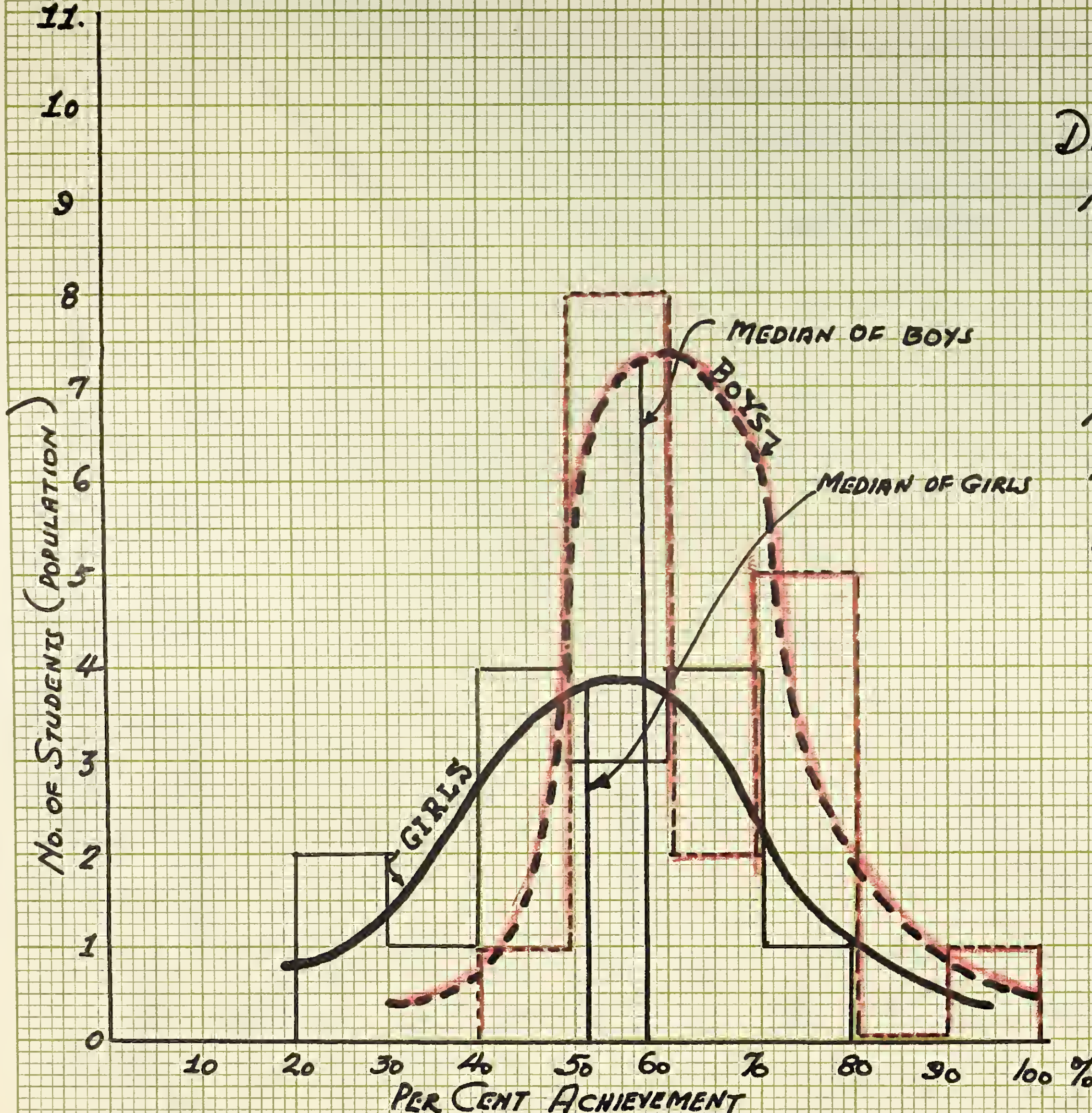


Fig. 13 .- Sex Distribution of Abilities in HEAT Unit Test

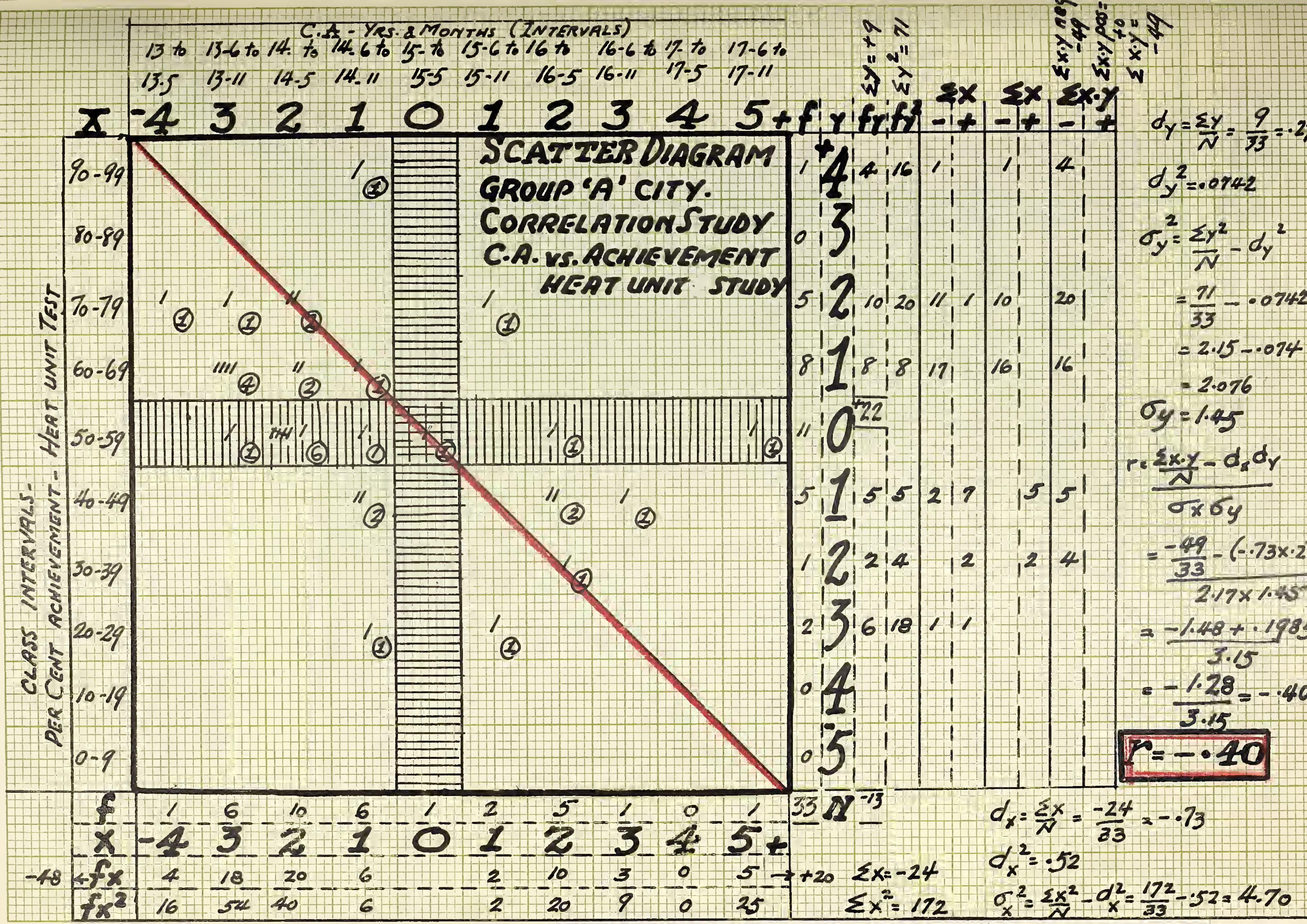


Fig.14.-Correlation Table or Graph Relationship Between C.A.& Achievement (Heat Unit test)

TABLE VI

ANALYSIS OF RESULTS OF TEST ON HEAT UNIT SHOWING RANK DISTRIBUTION OF FULL CLASS: KILLAM TOWN SCHOOL.
The table includes control group "B".

Student member	C.A. (Yrs, mos)	I.Q. (control group)	Interpretation of data	Application of principles	Science description.	Objective test discrimination	Science processes	Nature of proof	Total x 3/2
			TEST VALUES						
			(15)	(15)	(6)	(14)	(9)	(8)	100
1.P.C. girl	13-9	-	12	7	0	8	8	4	59
# 2.Sc.L boy	15-0	114	13	6	0	8	0	6	50
3.B.B. boy	14-6	-	7	4	0	7	8	2	42
4.V.F. girl	15-0	-	6	6	0	6	3	4	38
5.G.E. boy	14-6	-	6	5	0	6	6	2	38
6.J.F. girl	14-11	-	7	0	0	7	4	6	36
# 7.E.F. girl	15-8	86	4	2	0	10	0	4	30
Median position									
# 8.St.L boy	14-1	96	9	5	0	6	0	0	30
# 9.B.S. girl	14-0	113	3	1	0	7	3	5	29
#10.L.E. girl	14-3	-	7	4	0	7	0	0	27
#11.R.E. girl	15-5	101	3	6	0	6	0	3	27
12.H.W. girl	14-7	-	6	0	0	9	0	3	27
13.M.A. girl	14-7	-	1	3	0	5	2	6	26
#14.F.M. boy	15-10	95	3	1	0	7	0	0	17
15.S.E. boy		94	Absent						
Median of class			6.5	4.0	0	6.5	1.0	3.5	30
Median of control group			4.0	4.0	0	7.0	0.0	3.0	29

Note: # = control student

The table indicates that the group did not measure up nearly as well as did control group "A" from the city. Neither did they succeed as well as the lone or isolated students in groups "C" and "D".

Groups "C" and "D": Isolated rural students.

Table VII summarizes the performance of the lone students. The results for those who completed the work are very gratifying indeed. The standard of work sent in for evaluation was of a high order indicating a very satisfactory attitude and interest in the studies. This is a commendable observation and suggests the resourcefulness, motivation, and general point of view displayed by the correspondence student. In the writing of tests the isolated student was advised to refrain from referring to notes, texts, manuals. If these conditions were adhered to the test results are very praiseworthy.

TABLE VII

ANALYSIS OF RESULTS OF TEST ON HEAT UNIT, SHOWING RANK DISTRIBUTION OF ISOLATED STUDENTS: Groups "C" and "D".

Student member		C.A. (Yrs-mos)	Interpretation of data	Application of principles	Science description	Objective test discrimination	Science processes	Nature of proof	Total times 3/2 = 100
			TEST VALUES						
			(15)	(15)	(6)	(14)	(9)	(8)	100
1.Ca.K.	boy	13-7	15	13	5	10	9	8	90
2.Cl.D.	girl	16-11	12	10	6	13	9	8	87
3.B.P.	girl	14-8	10	12	5	12	5	6	75
4.Ch.E.	girl	13-10	10	12	5	10	5	8	71
5.B.F.	girl	15-10	9	8	2	9	7	5	60
6.G.C.	boy	15-9	12	11	2	12	8	6	77
7.E.M.	girl	13-8							
8.S.V.	boy	-							
9.D.J.	girl	14-11							

Students 7 to 9 had not completed assignments at the time of printing the thesis.

<u>Graphical summary, control group achievement.</u>-

Figure 15 is a comparison graph of achievement for the three types of control groups selected for this investigation. The medians of control groups "A", "B", and of combined "C"-"D" are plotted and indicate that the rural group did very commendable work; that the city group did satisfactory work; that the work of the town group was not satisfactory.

Figure 16 is a comparison graph of the achievement of the full class in town and city, The rural control group is plotted for the sake of comparison. The graph indicates that scattered abilities of full classes run approximately parallel to scattered abilities of control groups of varying I.Q.'s and C.A.

Fig. 15.-RELATIVE ACHIEVEMENT OF CONTROL GROUPS

-HEAT UNIT TEST-

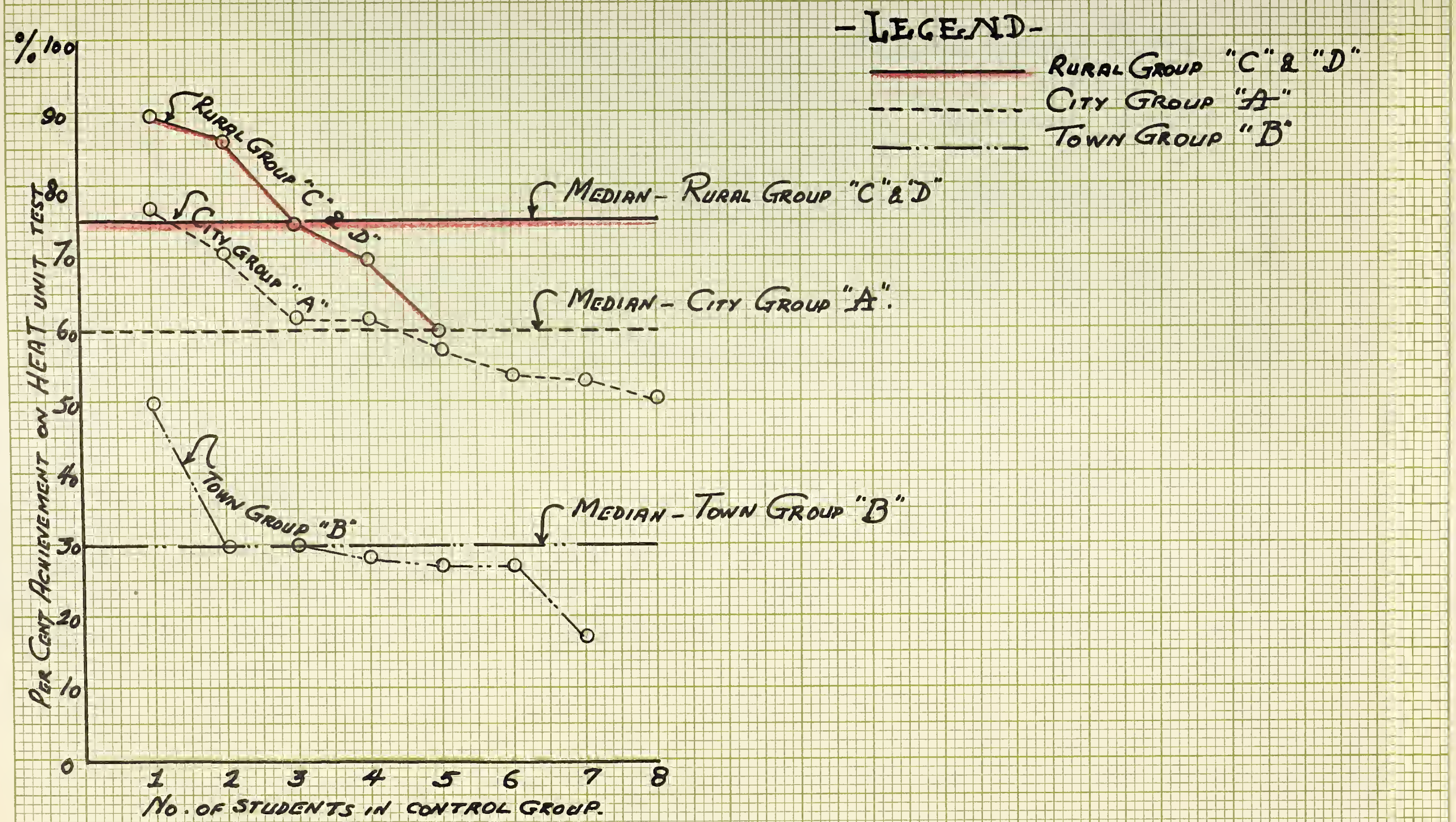
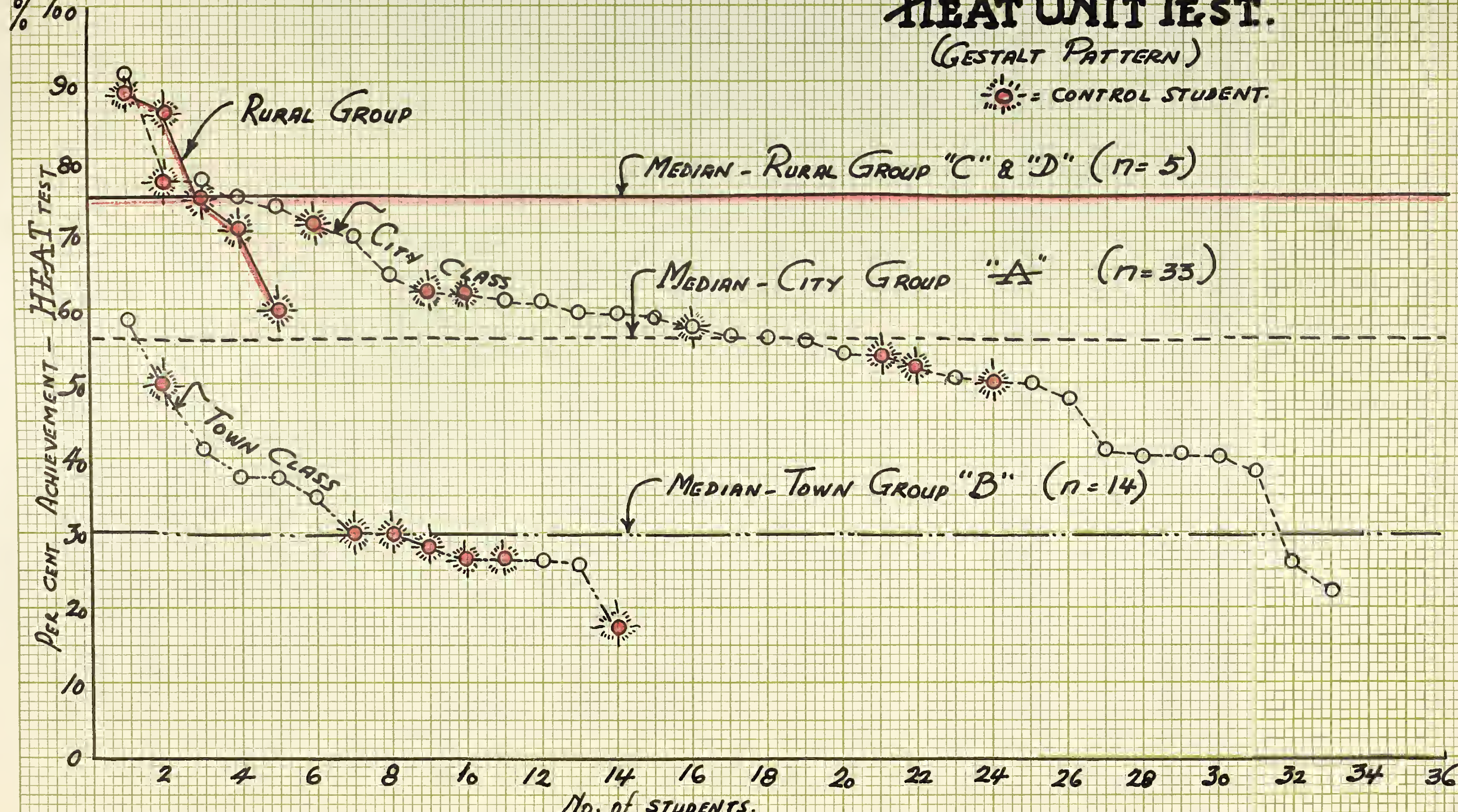


Fig.16.-**RELATIVE ACHIEVEMENT OF CITY & TOWN CLASSES.**

(RURAL CONTROL GROUP INCLUDED FOR COMPARISON PURPOSES)

HEAT UNIT TEST.

(GESTALT PATTERN)



4. Appreciations, skills and knowledges.

The questionnaire heretofore examined and summarized in this chapter indicates clearly that students in the course of their study have grown considerably in such desirable outcomes as: science appreciations, skills in manipulation of apparatus and of sketch work, and in knowledge essentials as evidenced in tests in the two units. This was especially true in the case of groups "A", "C", and "D".

5. Evaluation of the experiment by teachers, superintendents, and students.

(a) By teachers:

(i) The following is a quotation by the science teacher of the Normal Practice School, Calgary, Mr. A. L. Russell:

> "I was much attracted by your correspondence method of study of the units on HEAT and LIGHT in the Grade lX science course.
>
> I like the overview idea at the beginning of each study both because it helps the pupil to orient himself in the study and because, in the more detailed study of sub-topics it enables him to see these sub-topics in their proper perspective and in relation to all the other sub-topics. It gives a definite cohesiveness to the study without in the least divorcing it from the larger theme of which it is a part.
>
> The generous allowance for simple but pointed experimentation, largely with self- designed equipment, should I think appeal to the pupils as being something he is creating for his own use, and using to satisfy his own desire for information; a good stimulus to a wish to 'see for himself'.
>
> The charts and illustrations are vividly forceful and clearly explanatory and provide a striking method of "summing up". Results as I saw them were on a par with those from class room methods in most values and superior in appreciation of the subject and in the fundamental grasp of principles.
>
> Most of the ideas incorporated in the work could be used with good advantage in any classroom."
>
> (A.L. Russell)

(ii) Quotation from Mr. George Carter, intermediate school

teacher at Killam, Alberta.

"The idea of seeing the units as wholes is very very effective and seems to give a better grasp of the separate parts as a result. I have since used the same idea to the best advantage in other subjects where I had not used it before.

The lab manual is very well done.

I think the whole plan is the coming way of teaching science. I have tried to teach science along these lines but your method has given me some new ideas on how to approach it in the right manner so that pupils think of science in school and out in their every-day lives. My class seems to have lacked inherent curiosity about anything but I am now looking for improvement.

As far as correspondence courses go there could not be any better presentation of science. If a student is willing to take such a course you may rest assured that he will be ready to do his best because he sees that it is entirely up to himself to come through. I have examined a.......correspondence course and very little effort is made in producing interest in the subject. That I believe is one of the strong points of your work. You have gone to great pains to arouse interest before going on.

For myself I much appreciated the chance to get your new ideas and presentations."

(Geo. Carter)

(b) <u>Remarks by superintendents of rural divisions in Alberta.</u>

The study outlines[1] used by the students were sent to four divisional superintendents.

I have received an expression of opinion on the method outlined from all four .

These men are in close contact with the rural situation and are in a position to evaluate the material of the investigation in the light of the correspondence student.

Their comments follow:-

(i) Quotation from Mr. C. C. Bremner, Superintendent at MacLeod, Alberta.

---

1. See Appendix -

"I have checked over your material and I think it is splendid. I certainly like the manuals and think they are gems. I'd like to see the material available to all teachers and students. I believe it would be a great boon to every teacher with a grade lX. I like your approach and your way of making it interesting, and the simplicity should make it very useful. I have never seen anything as readable for a student. It should make a grand correspondence course."

(C.C. Bremner)

(ii) Quotation from Mr. Owen Williams, Superintendent at Lethbridge, Alberta.

"I have glanced over the books and even I can enjoy them. I believe you have hit the right spot in your diagnosis of the correspondence student."

(O.Williams)

(iii) Quotation from Mr. Claude Robinson, Superintendent at Camrose, Alberta.

"I have looked through your piece of work on the grade nine science and am very pleased with it. It strikes a familiar note with regard to my efforts. I have always tried to insist that work done in school should be closely related to the lives and experiences of the pupils outside the school. To put it in psychological language I suppose this would mean that life is one whole and that it should be treated as such. Life in the school is only part of the pupil's life and it should be related to it and a part of it at all times. Your approach to the science course would be useful to pupils not only doing correspondence and private study work, but to all. My experience with pupils in rural grade nine, with village grade nine and town grade nine, and with city grade nine leads me to think that the teachers in all areas need to have their ideas re-arranged. I feel that science should be taught as part of the whole curriculum and not as a departmentalized subject, a body of material which is the preserve of the science specialist. I note that you make an attempt to relate some of the other work to science.

I think you have something of value here and I hope you will not be satisfied to let it rest merely as a piece of work for a thesis.

(C.Robinson.)

(iv) Quotation from Mr. C. Laverty, Superintendent at Vermilion, Alberta.

"I like your general plan very much and the ideas and

simple get-up of your laboratory material is a step very much needed in the face of the strong commercial effort to prove that science demands a great supply of complicated boughten material.

I think that the grade nine pupil would develop many new and useful ideas from your work and perhaps learn to work more systematically besides getting a look at their course from a broader point view. I liked your sympathetic approach. The whole job appealed to me. I think your plan is alright.

(C. Laverty)

(d) A lone student: (one of several)

"I have really enjoyed this study with you. The pictures made things very clear to me and with the aid of the explanations following as I went along really made it enjoyable. The experiments were fun also----I have discovered a number of things which take place in my everyday life and which I had never discovered before. I am sure that from now on I shall take a greater interest in my general science."

6. Final generalized observations: -

(a) There was no observed correlation between C.A. and achievement in the tests on HEAT and LIGHT studies.

(b) In the HEAT test the city control group presented the following observations:

i. The student with the lowest I.Q. rating ranked highest in achievement.

ii. The student with the lowest C.A. rating ranked second highest in achievement.

iii. The student with the highest C.A. rating ranked highest in the control group.

(c) Correspondence groups show greater dependability when assigned a task calling for individual responsibility of the unsupervised type.

(d) Learning by wholes is as effective as either the habit-forming drill method, or the rationalizing of isolated and non-functional science topics.

CHAPTER VI

VERIFICATION OF THE EXPERIMENT

A second unit as an extension of the plan under test. -

In order to substantiate the new technique a second unit was prepared dealing with a unit on LIGHT from the grade IX programme of study. The aim was to re-conduct the experiment in order to establish claims for the initial conclusions. Identical procedure was followed, the student being directed by means of a specially prepared unit[1], a laboratory manual as guide to experimentation[2], and research readings from the text. The unit was concluded with test exercises[3] which were forwarded to me for correction and evaluation. The control groups followed the unit on LIGHT according to the 'whole to part' technique.

Possibility of others conducting the unit studies. -

By reference to the appended materials at the end of this thesis sufficient leads are given so that any person wishing to extend the investigations on gestaltic technique may do so. The general pattern outlined in chapter 4 has been adhered to in the preparation of the LIGHT study. This pattern we repeat here for convenience in further investigation work.

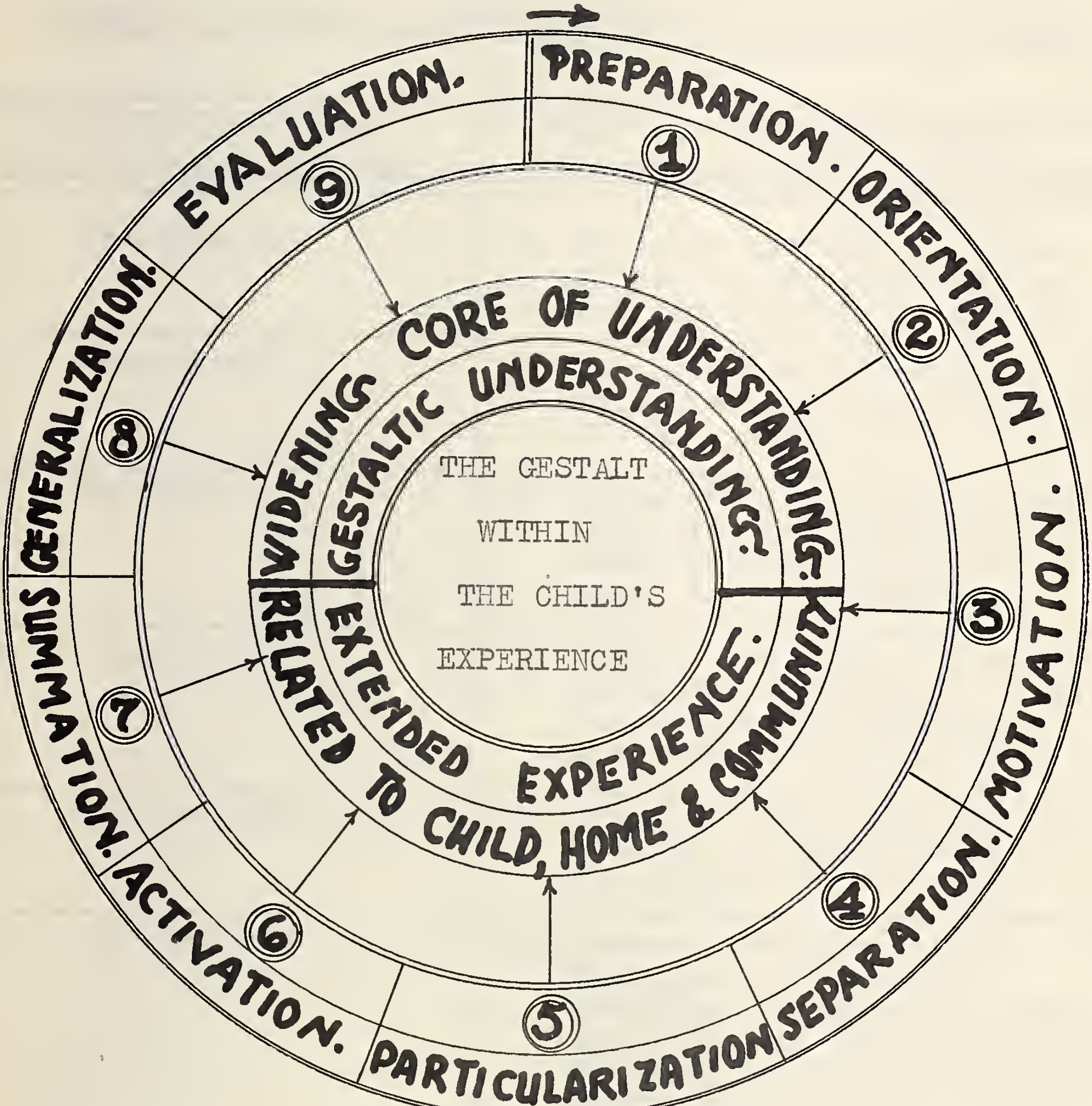
1. See appendix 6
2. See appendix 7
3. See appendix 8

STAGES IN GESTALTIC STUDY

1. PREPARATION: To make the student aware of a problem to be solved.
2. ORIENTATION: To direct the student so that he thinks in terms of wholes and which in turn lead to a desire to analyse the parts.
3. MOTIVATION: To arouse thought and interest through preliminary appreciations related to life.
4. SEPARATION: To analyse the gestaltic whole into its component parts or sub-wholes.
5. PARTICULARIZATION: To depict graphically and visually the particular details which shall lead to general concepts.
6. ACTIVATION: To provide for mental, physical, and emotional activity, through experimentation, conduct of exercises, research study, and extended readings.
7. SUMMATION: To re-view or sum up the sub-wholes into the integrated unit whole -- the gestalt.
8. GENERALIZATION: To deduce general concepts, statements, or laws.
9. EVALUATION: To test for skills, appreciations and knowledges.

It is interesting to represent this "learning by insight" in diagrammatic form, as shown in figure 17.

Fig.17-A FLOW CHART



ILLUSTRATING

THE ANALYSIS OF STAGES IN THE GESTALTIC

METHOD OF PRESENTATION

(as used in this experimental investigation)

3. <u>The general schemetic or plan of investigation relative to course designer and pupil participant</u>.-

TABLE VIII

PLAN FOR EXTENDED INVESTIGATION INTO GESTALT TECHNIQUE

The plan as viewed by the course designer	The task for the student, harmonized with the course design
1. Preparation	1. Guidance discussion from a manual of directions to set the problem for the child
2. Orientation	2. Mental direction of the pupil into the over-view treatment of the study.
3. Motivation	3. Stimulation of thought relationships, indicating how the study involves the self, the home, and the community.
4. Separation.	4. Careful indication of sub-divisions of the unit, treating the lesser parts as analyses of the main topic.
5. Particularization	5. Graphics and visual aids to develop an appreciation of the details of the study.
6. Activation	6. Student activity through readings, note-making, summaries, charts, diagrams, sketches, and experimentation. Training in critical thinking, nature of proof, and interpretation of data.
7. Summation	7. A re-view device in order to integrate sub-wholes or analytical parts into wholes.

8. Generalization	8. Direction of the student in generalized or abstract concepts.
9. Evaluation	9. Tests for appreciation, attitudes, skills, and knowledges.

Table VIII is submitted in order that others may extend the investigation in the gestaltic technique of subject presentation. The table itself is a gestaltic or full-view perspective of the plan of attack in the investigation.

4. Observations made in relation to the supplementary study.-

(a) The control groups retained approximately their same relative placement in the class achievement.

(b) The students of the control group demonstrated ready understanding of the second gestalt study after having 'caught on' to the first study unit.

(c) The results of the second unit served to confirm the finding that, for distributed intelligences, students do as well if not better by the 'whole-to-part' plan than under the routinized study of isolated topics.

(d) Science appreciations were in evidence throughout the second study. Students of the control groups felt they had arrived at appreciation standards which did not result from the customary textual study.

(e) Correspondence students continued to score higher than did the artificially controlled groups in city and town.

(f) Students who displayed poor attitude to self-study in the first unit showed little or no improvement in the second unit tested. In other words, they failed to accept the challenge of personal responsibility.

(g) For the city control group, the coefficient of correlation between the teacher-supervised HEAT unit test and the teacher-supervised LIGHT unit test was + .45. This figure indicates in a general way that those students who did poorly in the control experiment did relatively poorly in the regular class tests.

(h) One student in the city control group with an I.Q. of 114 who ranked sixteenth in a class of thirty-three on the final test in the HEAT unit, ranked first in the final test on the second unit on LIGHT. This young lady H.E., age 14 years, 5 months, showed evidence of marked science appreciation in the first unit, and had so completely 'found herself' by the time the second unit was completed that she showed evidence of both science knowledge and of science appreciation.

Examination into the achievement in the second unit on LIGHT.

The tables following will serve to indicate that the achievement of the control members of groups "A", "B","C", and "D" succeeded as well in the second unit as in the first unit studied. Scattered achievement according to wide range of

ability and attitude correlated quite well with the results of the first unit taken by the students. In other words, the results of the second unit substantiate the findings discovered in the first unit studied.

Analysis of results for Group "A", city control group. -

The analysis of the test results in the second unit are shown in table IX . For comparison purposes the test was administered to the full class in the city and town rooms, including both control and non-control members.

TABLE IX

ANALYSIS OF RESULTS OF TEST ON LIGHT UNIT SHOWING RANK DISTRIBUTION OF THE FULL CLASS: NORMAL PRACTICE SCHOOL.

The table includes control group "A".

Student member	QUESTION TYPES Value of question bracketed at head of columns below. Total test amounted to 50 points; final total doubled.						
	RECALL (4)	EXPERIMENT (5)	INTERPRETATION OF DATA (11)	DIAGRAM STUDY (10)	SCIENCE TERMS (12)	ESSAY (8)	TOTAL times 2 100
# 1.H.E. girl	4	4	10	10	12	6	92
2.H.D. boy	3	5	10	10	10	6	88
3.M.N. boy	4	5	11	9	10	4	86
4.M.J. boy	4	5	11	10	7	5	84
5.H.J. girl	2	5	10	10	7	7	82
6.M.B. boy	4	5	7	10	11	2	78
7.D.B. girl	3	4	7	10	11	3	76
8.L.G. girl	3	5	10	10	6	4	76
9.H.J. girl	4	5	8	7	9	5	76
#10.R.R. boy	2	5	6	10	11	3	74
#11.P.P. boy	2	5	5	8	11	5	72
12.R.N. girl	4	5	9	7	7	2	68
#13.M.R. girl	4	5	6	10	6	2	66
14.G.C. boy	4	4	6	9	7	2	64
15.W.H. boy	3	3	3	10	10	2	62
16.C.F. boy	3	4	7	10	4	3	62
	Median position						
#17.B.I. girl	2	5	8	7	2	6	60
18.E.G. girl	3	5	6	10	3	3	60
19.H.D. girl	4	4	3	7	9	2	58
#20.M.G. girl	4	0	9	6	4	6	58
21.I.R. girl	3	4	7	10	0	4	56
22.G.J. girl	3	4	8	9	4	0	56
23.M.L. girl	4	4	5	8	2	5	56
# 24.K.B. boy	4	5	4	10	1	3	54
25.M.J. girl	3	3	7	7	6	1	54
# 26.S.A. boy	3	4	2	10	5	3	54
27.B.G. boy	2	4	6	10	4	0	52
28.A.G. boy	2	5	6	9	0	3	50
	Pass Line						
29.G.H. girl.	4	4	3	7	3	2	46
30.L.J. boy	4	4	1	9	2	3	46
31.A.C. girl	2	0	1	7	9	1	40
32.P.B. boy	2	0	4	3	7	3	38
33.R.L. girl	1	2	5	4	2	1	34
Median Class	3.5	4.5	6.5	9.5	6.5	3.0	61
Median Control Students	3.5	4.5	7.0	10.0	5.5	4.0	63

= control student.

The control group were slightly superior to the non-control members, in the LIGHT unit test.

A comparison of ranks for the eight students of the city control group in the unit tests in HEAT and LIGHT is shown in table X . The table was prepared from achievement tests administered to the control groups under the supervision of the regular room teacher.

TABLE X

A COMPARISON OF RANKS OF CITY CONTROL GROUP "A", IN THE UNIT TESTS ON HEAT AND LIGHT.

Students of city control group	I.Q.	C.A. yrs. & mos.	HEAT TEST		LIGHT TEST	
			Rank in class of 33	Rank in control group of 8	Rank in class of 33	Rank in control group of 8
1. R.R.	92	15-8	2	1	10	2
2. P.P.	129	13-0	6	2	11	3
3. K.B.	131	13-9	9	3	24	7
4. M.G.	107	14-5	9	4	20	6
5. H.E.	114	14-5	16	5	1	1
6. B.I.	95	14-2	20	6	17	5
7. M.R.	124	14-5	22	7	13	4
8. S.A.	113	13-10	23	8	26	8

By inspection of table X the control-group ranking in the two tests was rather uniform indicating some degree of constancy. Students numbered 1,2,4,6, and 8 are quite consistent in their ranking. Student 5 (already discussed) moved to top place in the second study, after having 'caught on' to the method of 'whole-presentation'. The control ranking is more significant than the full-class ranking since only the control group studied according to the method of wholes. The table shows clearly that with varied I.Q. and C.A., the student achievement is distributed over a considerable range.

The coefficient of correlation by ranks has been calculated for the data in table XI . The coefficient $r = + .45$ (table XI) indicates a measure of correlation between ranks in the first and second unit tests.

TABLE XI

CALCULATION OF CORRELATION COEFFICIENT BY RANKS FOR THE CITY CONTROL GROUP "A", IN THE UNIT TESTS ON HEAT AND LIGHT.

Student of the control group	Rank in HEAT unit test	Rank in LIGHT unit test	Difference between ranks	Difference squared
#	k_x	k_y	d	d^2
1. R.R.	1	2	1	1
2. P.P.	2	3	1	1
3. K.B.	3	7	4	16
4. M.G.	4	6	2	4
5. H.E.	5	1	4	16
6. B.I.	6	5	1	1
7. M.R.	7	4	3	9
8. S.A.	8	8	0	0

$$\Sigma (k_x - k_y)^2 = 48$$

$$6 \Sigma (k_x - k_y)^2 = 288$$

$$n = 8$$

$$n (n^2 - 1) = 504$$

$$\rho = 1 - \frac{6 \Sigma (k_x - k_y)^2}{n (n^2 - 1)} = 1 - \frac{288}{504} = .43$$

By transposition, $r = .45$ positive

It is evident that the individual rank placement for the various members of control group "A", of varied I.Q. and C.A. , was distributed throughout the class. Four of the eight control students ranked above the median and four below;

all eight students ranked above the pass line. Abilities in this LIGHT unit test were evenly distributed between the sexes. The results correlate generally with the results of the previous HEAT study, and in both studies the results are favourable and quite conclusive.

Analysis of results for group "B": Town control group. - This control group performed poorly in (1) the HEAT unit test, (2) the LIGHT unit test, and (3) the special LIGHT test prepared by the regular room teacher. Later correlation figures will serve to indicate that neither control group nor non-control group have a very sound grasp of science and of science principles. The investigation into this town group and into their science abilities is included as a necessary digression from the main purpose of this thesis. Table XII summates group "B" achievement in the Light unit study.

TABLE XII
ANALYSIS OF RESULTS OF TEST ON LIGHT UNIT, SHOWING RANK DISTRIBUTION OF THE FULL CLASS: TOWN OF KILLAM.
The table includes the members of control group "B".

Student member	QUESTION TYPES (Value of question bracketed below the type) (Total test 50 points; final total doubled) RECALL (4)	EXPER-IMENT (5)	INTERPRET-ING DATA (11)	DIAGRAM (10)	TERMS (12)	ESSAY (8)	TOTAL TIMES two (100)
1.P.C. girl	4	2	9	7	2	5	58
2.B.B. boy	1	4	6	10	5	2	56
# 3.B.S. girl	2	3	5	10	1	6	54
# 4.L.E. girl	2	2	4	10	0	3	42
5.J.F. girl	3	0	6	6	2	4	42
# 6.Sc.L.boy	1	5	3	8	0	3	40
7.V.F. girl	1	4	7	4	0	4	40
	Median position						
# 8.R.E. girl	1	2	2	7	0	3	30
9.M.A. girl	2	4	3	2	1	1	26
#10.S.E. boy	1	3	3	6	0	0	26
11.H.W. girl	2	0	2	6	0	2	24
#12.F.M. boy	1	2	4	2	0	2	22
#13.St.L.boy	1	0	2	4	0	3	20
#14.E.F. girl	1	3	2	4	0	0	20
Median class	1.5	2.5	3.5	6.5	0.5	3.0	35
Median Control member	1.0	2.5	3.0	6.5	0.5	2.5	28

= control member

By comparing the median achievement in the total test and also in individual test items, with the results of the city control group "A" it is readily apparent that the standing of "B" control group is very much lower. The test summary in table XII is rather discouraging and is unfair to the experimental investigation. The class median is not at all high . A pass figure of 50% would be indicative of very unsatisfactory effort on the part

of the "B" control group. Furthermore the test summary indicates mediocre understanding and appreciation in science on the part of all class members. It is considered worthwhile, in order to defend the experimental investigation, to include here a brief case resumé of the attitudes and dispositions of individual members of the "B" control group as furnished by the room teacher. These histories indicate the readiness of the individual to 'play the game' and to assume personal responsibility.

Student No.3. TableXII-

B.S. (I.Q. 113, C.A. 14-0): "Steady student; good reader; wide interests; careful and conscientious; requires very little coaxing or urging; responds readily to motivation; takes pride in doing a good job; has careful, minute, and practical habits of work and study; her science notebook has all experiments recorded, neatly and completely. This is one student that put much into it."

Student No.4. TableXII-

L.E. (I.Q. - , C.A. 14-3) : "One person who, I am afraid poisoned the minds of those that were interested. She appeared quite enthusiastic at the beginning and halfway through wanted to quit. However, I requested that she continue to the end of the unit considering the fact that she had started. Became stubborn and did very little work. She does not like science and her tastes are definitely in the literature class. She next complained to me that she could not understand the questions; merely an excuse I judged but advised her to ask questions of you and I would see that you received them. This she never took the trouble to do. Her other subjects are very neatly kept up and she is quite conscientious about the subjects she enjoys. Besides being the best writer in the school she has in addition the most neatly kept science scribbler in my experiment work. This is because Art is one of her likes. For those subjects she dislikes, more motivation is required than for any other pupil in the grade. I frankly don't understand the girl yet. She is an orphan, a newcomer of this year, sometimes a discipline problem, which has been solved by a heart to heart talk. Her brothers are putting her through school and she really wants to make it. I expect from her some very startling criticisms of your unit, but do not be dismayed. Perhaps if she does, this insight into as much of her character as I can give, may help."

Student No.6, Table XII.-

S.L. (I.Q. 114,C.A. 15-0): "Last year's scholarship winner; steady,neat; consider him my ace student; does things to the very best of his ability; grown up views; mother dead; oldest in family; ambitious and has taken responsibility ever since he could walk. You should get quite an honest questionnaire from this lad. He is quite frank, honest, and adult in his views with me. The most careful thinker in the class. Should have received a lot from your unit."

Student No.8.Table XII.-

R.E. (I.Q. 101, C.A. 15-5): "Showed me a very well completed notebook. Used to be one of my most careless and lazy girls. However, there has been quite a noticeable change this term for which I am only partly able to account. Has more boyish interests in the realm of science than the other girls. She still needs a guiding hand however, because until this year has been more or less forced to do what work she did. She like all the others, as you found have the one difficulty, viz., the ability to apply knowledge."

Student No. 10, Table XII .-

S.E. (I.Q. 94, C.A. 14-6): "Less said about this gentleman of leisure the better. Have had talk with parents and they are forcing him to go to school. Only subject which has an atom of interest for him is science. Likes cars and physical labor; he has never heard of mental labor. His options are a thing of the past. He will not be writing finals unless something radical happens. Aims to be an airplane pilot and does not believe me when I inform him that he has to prove ability by passing grade nine before he is given responsibility. If he does not do well for you, it isn't because he doesn't know his science, because that appears to be one subject he knows as well as any--which still isn't saying much, but because he was too bored to put it down. His mother says he brought an apple box and that was the extent of his experiments with probably one exception--the sulphur and potassium chlorate experiment which he would loved to have performed in school and out a hundred times."

Student No. 12, Table XII. -

F.M. (I.Q. 95, C.A. 15-10): "Not very practical in regard to science but is only aware of those things that have been stuck underneath his nose so that he cannot help seeing them. Does very little when

presented with new situations. Definitely lazy and needs to be goaded. Can be motivated intensely for a short time but his span of attention is limited, either because of an inherent inertia or lack of understanding. Have not seen his notebook, and perhaps never will now. He missed the first month at school and was therefore so far behind that he became discouraged and he did not have what it takes to stay with it. Seemed however to get quite an enjoyment out of the experiments, as did all the boys."

Student No. 13, Table XII. -

St.L. (I.Q. 96, C.A. 14-1): "Opposite to No. 6; slow thinker; not overly bright; half interested in school; has had to be checked for misdemeanours such as truancy, etc. Does enough to get by. No problem in school, except it is harder to get him thinking than to pull teeth. Very immature in his views. Middle boy in a family of five; home life accounts for part of his attitude; square peg type. Likes science; easily motivated in line of experiments but doesn't know what they are for when they are set up."

Student No. 14. Table XII. -

E. F. (I.Q. 86, C. A. 15-8): "Steady; solid; very slow of perception; frankly dull in some subjects; does not need forcing however. Honest worker and likewise slow. Careful work as a rule but shows signs of careless thinking. Hasn't yet grasped good sentence sense in spite of drill and teaching. Scientific attitude nil. Seems to have very little ability to apply the practical application of same. Furthermore, this last term she has not been feeling well and has been doing as well as could be expected under these circumstances."

Due to lack of alertness, inability to assume responsibility, and generally negative attitude, it has been unfortunate that the foregoing group were included in the investigation. The case histories have been included as data in order to show that it was not possible to expect satisfactory results from group "B". The LIGHT test results correlate with those of the HEAT unit test in Chapter V, being generally unfavorable in both instances.

The investigation into the unsatisfactory attack of this

control group has been rather interesting for study purposes. There appears to be conclusive and positive correlation between the test results, the general attitude to work, and their all-round personalities. As a digression from the main experiment, and with an indirect bearing on this thesis, this particular control group will be looked into further.

The regular room teacher prepared a test for the whole class, based on his presentation of the LIGHT topic according to his own liking and disregarding the experimental material of this thesis. The tests were forwarded to me to be marked, after which they were returned to the room teacher. The results of the test are given in table XIII.

TABLE XIII

DISTRIBUTION BY RANK OF TOWN CONTROL GROUP ON THE REGULAR TEACHER'S TEST OF THE LIGHT UNIT.

Town of Killam.

Student of class group	I.Q. of control group	C.A. of control group	Percentage
# 1. Sc.L.	114	15-0	64
2. P.C.	-	13-9	64
3. J.F.	-	14-11	57
4. M.A.	-	14-8	49
5. V. F.	-	15-0	48
6. B.V.	-	14-0	48
# 7. R.E.	101	15-5	40
# 8. B.S.	113	14-0	36
# 9. S.E.	94	14-6	36
10. H.W.	-	14-7	33
#11. E.F.	86	15-8	31
#12. L.E.	-	14-3	28
#13. F.M.	95	15-10	24
#14. S.L.	96	14-3	21

Median of non-control group 48.5
Median of full class group 38.0
Median of control group 33.5
= control group member

Summary conclusions; relative to control group "B". -

(1) That the control group was not a satisfactory body for the experimental work being investigated. They showed poor workmanship in the tests, unsatisfactory penmanship, and generally careless thinking.

(2) In science understandings the group did little better in the unit studies than for their regular teacher. The experiment submitted demanded persistence and qualities common to progressive educational methods.
These were not in evidence.

(3) The case histories serve to explain the meagre results obtained.

(4) The control group did no poorer in the gestaltic method than in the regular routine method of teacher presentation. Most of the group are of the type who sit and wait to be worked upon.

Table XIVgives a summary picture of the achievement of control group "B".

TABLE XIV

COMPARATIVE ANALYSIS OF RANK DISTRIBUTIONS BETWEEN RESULTS ON LIGHT TEST UNDER THE FORMAL PRESENTATION AND LIGHT TEST UNDER GESTALTIC PRESENTATION.
Town of Killam, including control group "B".

Student member of class group	LIGHT TEST Formal presentation by teacher		LIGHT TEST Gestaltic self-study		Preference by student
	Per Cent	Rank	Per Cent	Rank	
# 1. Sc.L.	64	# 1	40	# 6	Formal presentation
2. P.C.	64	1	58	1	Constant performance
3. J.F.	57	3	42	4	Constant performance
4. M.A.	49	4	26	9	Formal presentation
5. V.F.	48	5	40	6	Constant performance
6. B.B.	48	5	56	2	Better in self-study
# 7. R.E.	40	# 7	30	# 8	Constant performance
# 8. B.S.	36	# 8	54	# 3	Better in self-study
# 9. S.E.	36	# 8	26	# 9	Constant performance
10. H.W.	33	10	24	11	Constant performance
#11. E.F.	31	#11	20	#13	Constant performance
#12. L.E.	28	#12	42	# 4	Better in self-study
#13. F.M.	24	#13	22	#12	Constant performance
#14. St.L.	21	#14	20	#13	Constant performance
Median of control group	33.5		28.0		
Median of non-control group	48.5		41.0		
Median of whole class	38.0		35.0		

The table gives a clear indication that the attitude of control group "B" is not sufficiently satisfactory as to be of significant value in the experiment.

Table XV is the correlation table of achievement in the two unit studies as accomplished by Group "B".

TABLE XV

RANK CORRELATION ON LIGHT TESTS BY LOGICAL AND BY THE GESTALTIC METHODS OF PRESENTATION: Town group "B".

Student member of the whole class	Score in X	Score in Y	Rank in X	Rank in Y	Difference between ranks	Difference squared
	X	Y	k_x	k_y	d	d^2
# 1.Sc.L.	64	40	1	6	5	25
2.P.C.	64	58	1	1	0	0
3.J.F.	57	42	3	4	1	1
4.M.A.	49	26	4	9	5	25
5.V.F.	48	40	5	6	1	1
6.B.B.	48	56	5	2	3	9
# 7.R.E.	40	30	7	8	1	1
# 8.B.S.	36	54	8	3	5	25
# 9.S.E.	36	26	8	9	1	1
10.H.W.	33	24	10	11	1	1
#11.E.F.	31	20	11	13	2	4
#12.L.E.	28	42	12	4	8	64
#13.F.M.	24	22	13	12	1	1
#14.St.L.	21	20	14	13	1	1

$$\Sigma (k_x - k_y)^2 = 159$$

$$6 \Sigma (k_x - k_y)^2 = 954$$

$$n = 14$$

$$n(n^2 - 1) = 2730$$

$$\rho = 1 - \frac{6 (k_x - k_y)^2}{n(n^2 - 1)} = 1 - \frac{954}{2730} = .65 \text{ pos.}$$

Transposing: $r = + .668 = + .67$ approx.

The coefficient of (.67 positive) is really significant and furnishes conclusive evidence that the unfavorable results of the town control group is due to poor attitude, careless workmanship, and mediocre ability rather than the fault of the

gestaltic method. No method can succeed without genuine effort. It is held that the statistical evidence had to be submitted in order to establish a defence of the gestaltic method under investigation.

<u>Analysis of results for groups "C" and "D" isolated or lone correspondence students.</u>

For the students who had reported in time to have names entered in the table below, the results were as shown in table XVI.

Table XVI
TABULATED RESULTS OF CORRESPONDENCE CONTROL GROUP ON THE <u>LIGHT</u> TEST UNDER THE GESTALTIC PLAN.
Groups "C" and "D": lone students.

Student member	Sex	C.A.	QUESTION TYPES						
			RECALL (Value 4)	EXPERIMENT (Value 5)	INTERPRETING DATA (Value 11)	DIAGRAM STUDY (Value 10)	SCIENCE TERMS (Value 12)	ESSAY WORK (Value 8)	TOTAL x 2 = 100
1. Ca.K.	boy	13-7	3	6	10	10	12	8	98
2. Ch.E.	girl	13-10	4	5	11	8	12	8	96
3. Cl.D.	girl	16-11	4	5	10	10	12	7	96
4. Bi.P.	girl	14-8	4	5	10	4	12	8	86
5. Bo.F.	girl	15-10	4	4	6	2	11	4	62
6. G.C.	Boy	15-9	4	5	8	9	12	6	80
7. E.M.	girl	13-8			Tests not completed				
8. S.V.	boy								
9. D.J.	girl	14-11							

Note: Students 7 to 9 had not completed the tests at time of printing this thesis.

As in Chapter V, it is quite apparent that, assuming a desire on the part of the correspondence student to proceed to completion with a course, the individual carries out a thorough and conscientious task. The contribution made by groups "C" and "D" to the investigation have been very pleasing indeed.

Graphical representation of data:

Figure 18 is a graphical representation of achievement on the LIGHT unit for the complete city control group. The frequency polygon again shows a normal distribution of abilities both for the full class group and for the eight control group members. We may conclude that the success of city control group, of varied I.Q.'s support the findings of the first unit study, viz. that in this particular test, they did as well as, and probably better than they would otherwise have done without the gestaltic training.

Figure 19 represents the sex distribution of relative abilities in the LIGHT unit test for the full city class. The conclusions in regard to median performance correlate with the findings in the HEAT unit study.

Figure 20 is a comparison graph of achievement for the three types of control groups, "A", "B", and combined "C"-"D". The medians are shown for each of the three groups. The rural group stand highest in performance; the town group lowest; the city group in between.

Figure 21 shows the relative achievement of city and town classes in the Light unit test.

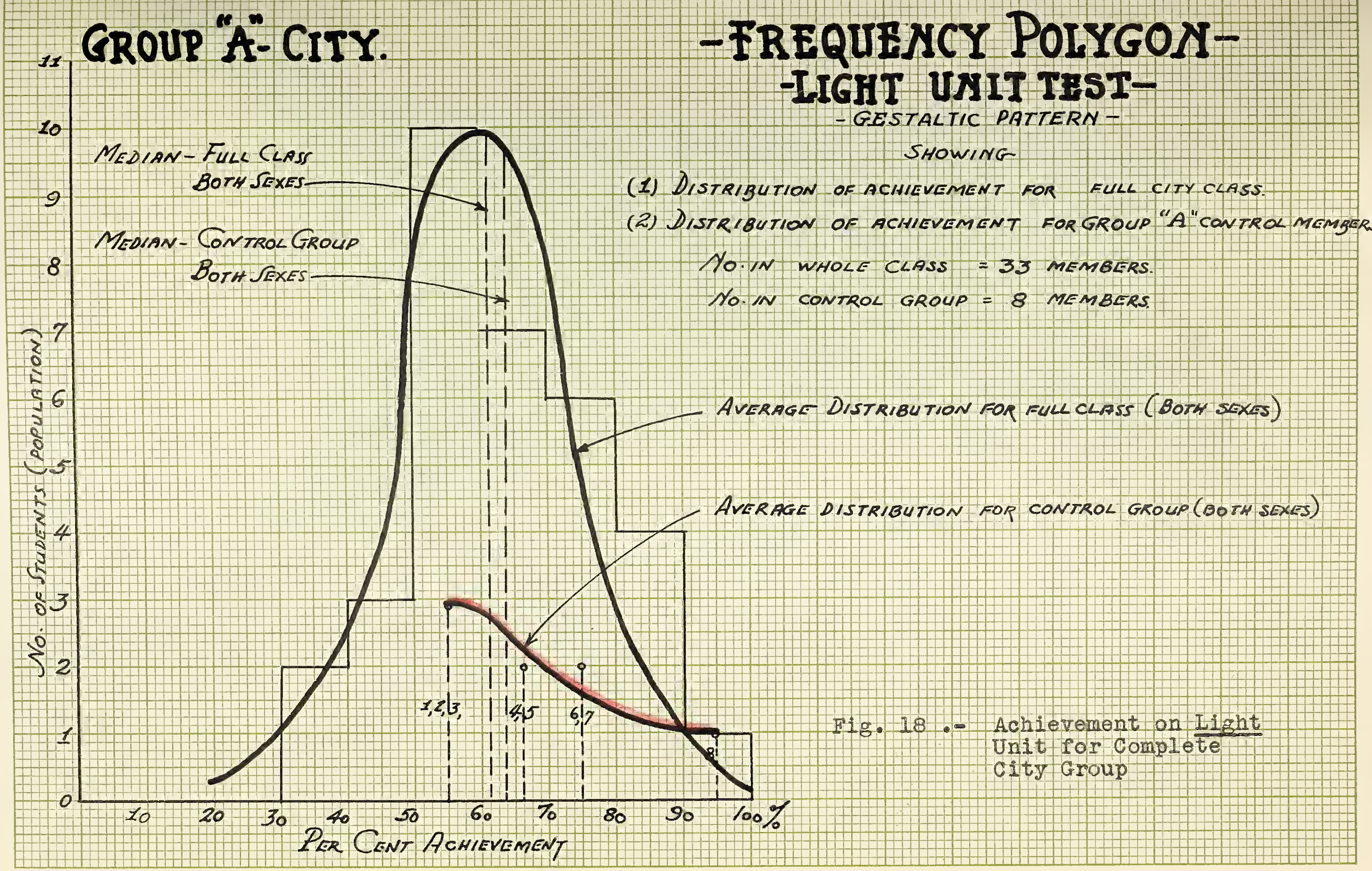


Fig. 18 .- Achievement on Light Unit for Complete City Group

GROUP "A" CITY.

-FREQUENCY POLYGONS-
-LIGHT UNIT TEST-
- GESTALTIC PLAN -

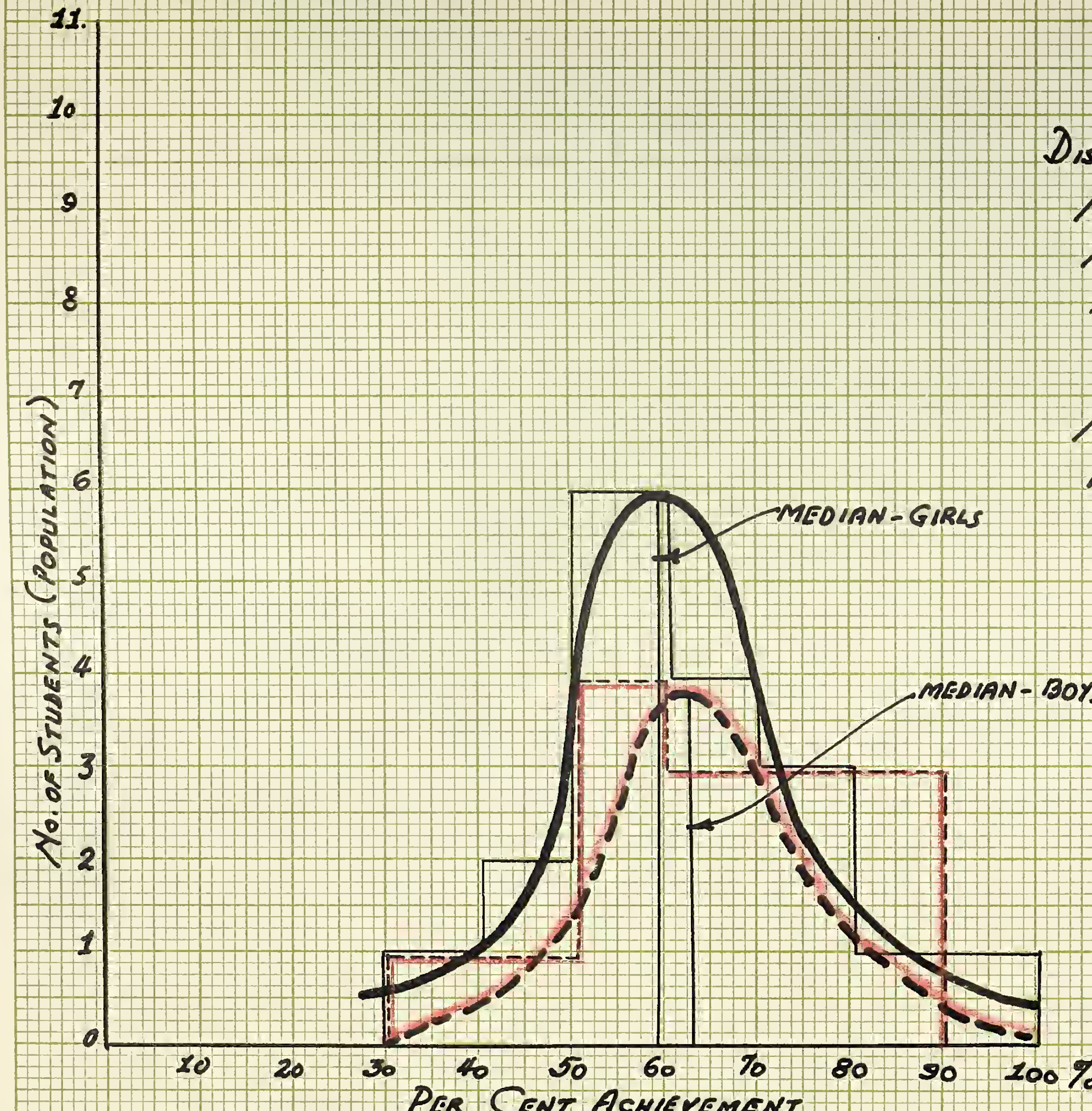
SHOWING

DISTRIBUTION OF ABILITIES BY SEXES.

NO. IN WHOLE CLASS	= 33.
NO. OF BOYS	= 15.
NO. OF GIRLS	= 17.

MEDIAN PERFORMANCE OF BOYS SLIGHTLY HIGHER THAN FOR GIRLS.

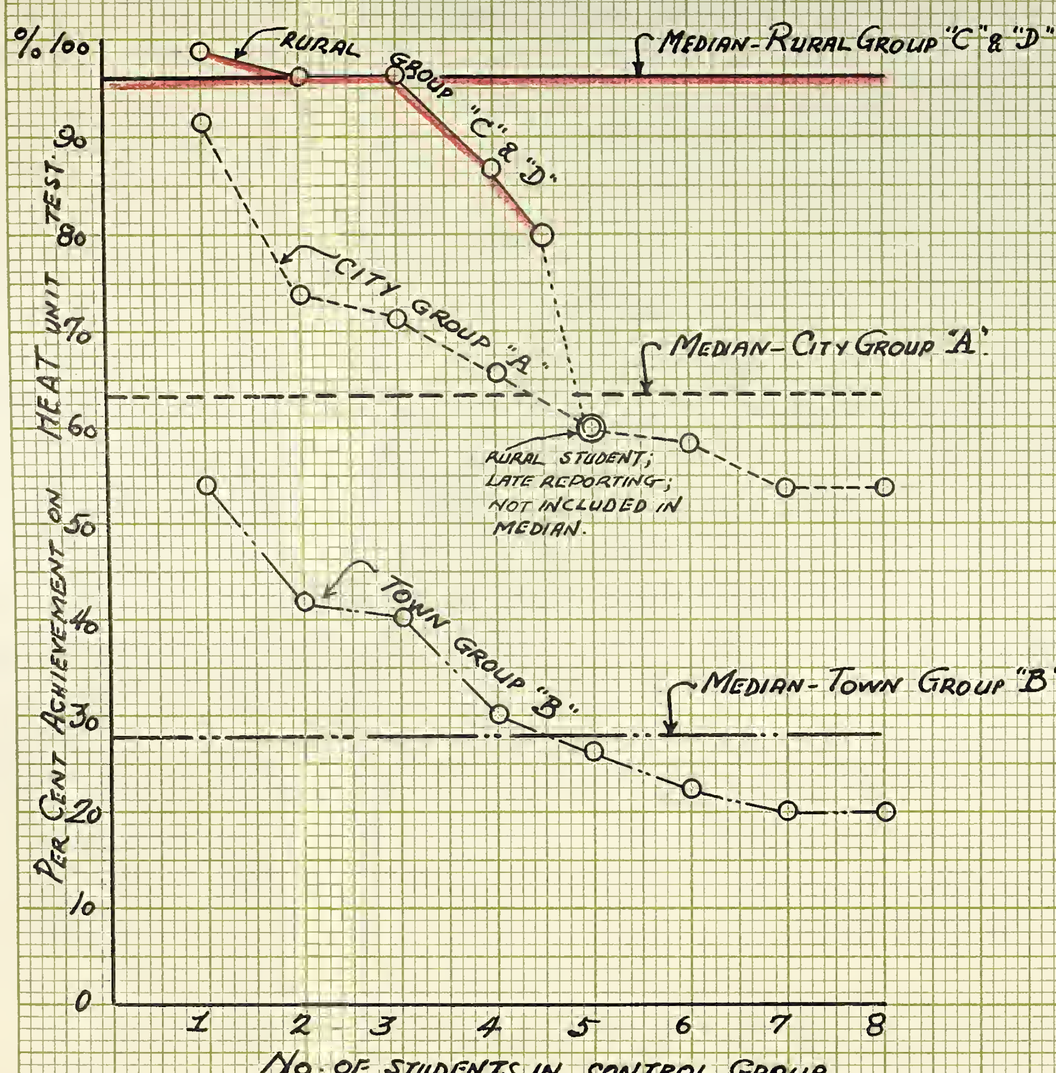
(11 STUDENTS OVER 15 YEARS OF AGE)



LEGEND: ———— GIRLS
– – – – BOYS

Fig. 19. - Sex Distribution of Relative Abilities in the Light Unit Test- Full City Class

RELATIVE ACHIEVEMENT OF CONTROL GROUPS.
-LIGHT UNIT TEST-



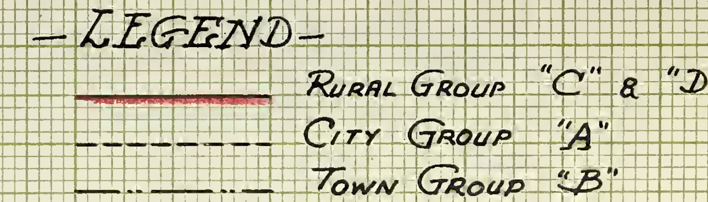


Fig. 20.- Comparative Achievement for the Three Control Groups in <u>Light</u> Unit Test

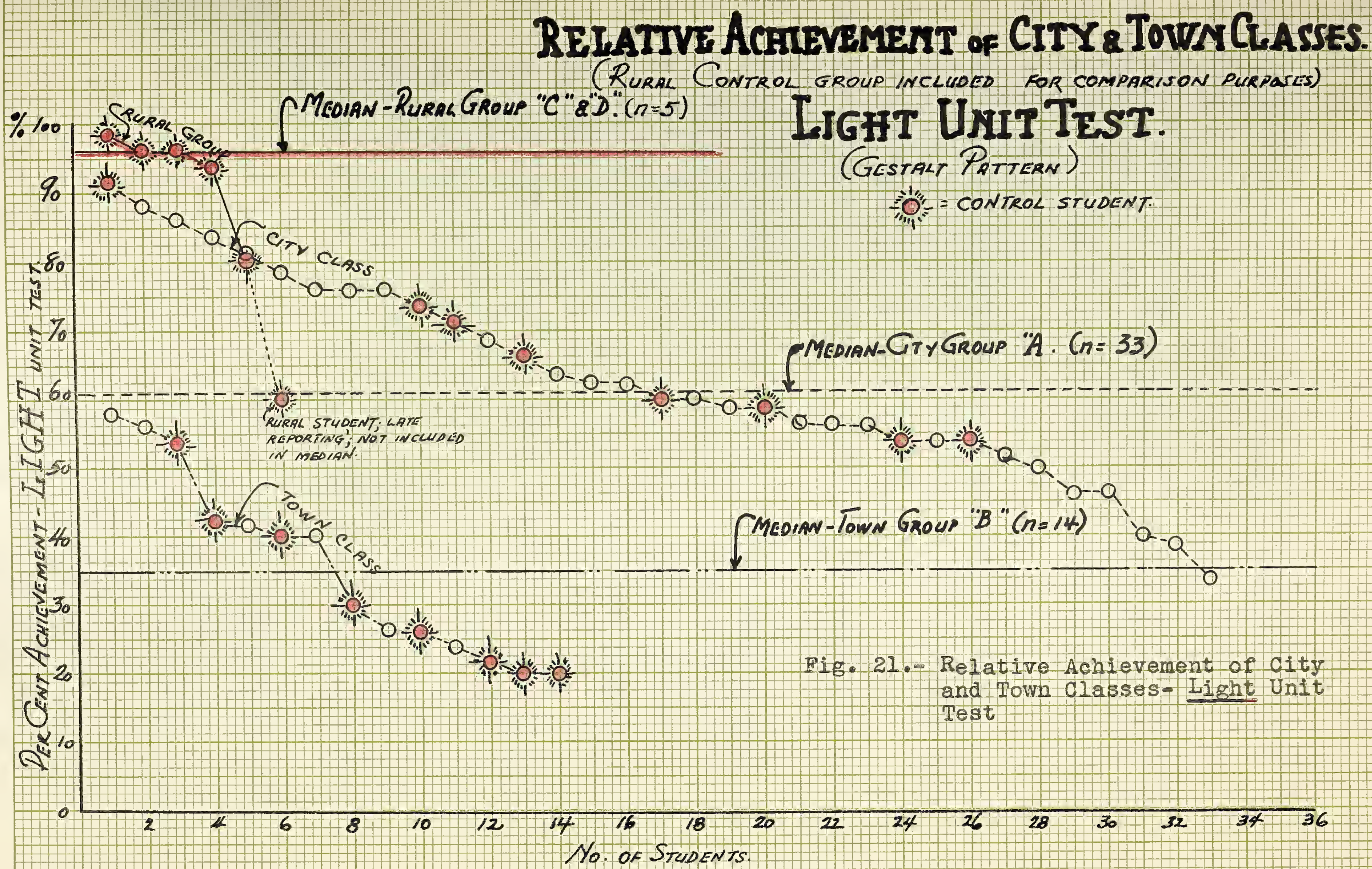


Fig. 21.- Relative Achievement of City and Town Classes- Light Unit Test

CHAPTER VII

CONCLUSIONS, AND POSSIBILITY OF GENERAL APPLICATION OF FINDINGS

This chapter terminates the investigation by presenting a summation of decisive items which should furnish convincing argument for the stand taken in Chapter II relative to the purpose of the study.

1. <u>General findings relative to correspondence courses.</u> -

It is contended that the gestaltic plan as examined in this control experiment proves the following:

(a) science can and should be presented through local and experiential media.

(b) science in order to build in the child attitudes of appreciation must be presented in terms of its developments and of its applications to man's comforts.

(c) appreciation of the forces of nature's environment is possible of direction in a science subject.

(d) the scientific method is experienced not only by laboratory experimentation but also by research studies, and problem-solving.

(e) science experimentation is an essential requirement of a correspondence course or of any other type of science course.

(f) the psychological method may be extended from the immediate to the mediate experiences of the child.

(g) the pragmatic or practical approach by relating the study to life, is a definite possibility.

(h) gestaltism as learning by 'insight' is possible in a content subject.

(i) self-study in science must be very skilfully and resourcefully guided.

(j) students appreciate working from large wholes to lesser parts.

(k) interest and motivation of self-study in science is possible provided skilful direction is established.

(l) much benefit accrues from the improvisation involved in self-study work.

(m) the over-view and re-view plan is of definite value in correspondence courses.

(n) generalized concepts require some directional treatment.

(o) factual learning as such is to be discounted and only utilized as a means of interpreting knowledge.

All in all, the investigation proved fruitful. Because of the wide distribution of intelligences (86 to 131) and of varied attitudes in the control groups, complete success for the technique was not to be expected. There existed a wide range of types in the experimental groups: the disinterested type, the extremely interested, the over-age dull, the over-age interested, the girl type, the boy type, the meagre back-ground type, the nationality type, the type with an adverse home environment, the diverted interested type and so on. The one factor which was maintained as a constant was the method or technique of presentation.

I have experimented on the method of wholes for several

years with my own Normal School students and the results are significant. Some classes have been subjected to the lecture-plan by proceeding from topic to topic; others have been subjected to the gestaltic method of presentation; the latter group invariably prove more successful in achievement and in their appreciations of science.

<u>Specific requirements of correspondence courses as discovered in the investigation</u>:

(a) the need of an apparatus kit for experimentation.

(b) printed labels, indicating care to be exercised in the handling of the various items in the kit.

(c) ointment tins as convenient receptacles for chemicals.

(d) a loose-leaf plan for student notebook work.

(e) definite instructions regarding the writing of exercises and experimental activities.

(f) diagram studies for the interpretation of science understandings.

(g) personal contact corresponding to teacher-pupil inspiration, established through a conversational technique in lessons.

2. <u>Psychological and practical conclusions to the experiment</u>. -

The interest factor is axiomatic in any learning situation. The responses to the questionnaire indicate that if provision is made for proper motivation by diagrammatic perspectives, the technique of wholes is favorable to learning by correspondence methods. This device has been responsible for arousing and maintaining pupil interest.

PRACTICAL CONCLUSIONS:

1. Isolated control groups, under sound guidance, perform well.
2. To replace the lack of teacher personality, skilful guidance in lessons, over and above mere textual studies, is needed.
3. Students do not suffer from exclusion or isolation if studies are made thoroughly real.
4. The isolated student must have illustrative material in the lesson helps.
5. Marking of tests must be standardized and unbiased. A uniform standard of judgment is difficult to maintain when exercises do not come in regularly.

<u>Features to be considered from the standpoint of student activity in a correspondence plan of work</u>.

(a) More attention to penmanship.

(b) A definite need for supervising English errors.

(c) Emphasis on the spelling of technical and of non-technical words.

(d) Use of the dictionary in the interpretation of new words.

(e) A <u>simple</u> explanation of the scientific method.

(f) Appreciation of the value of the scientific method in experimentation.

(g) Lesson materials written in an appealing way in order to impress the girl students, who are usually prone to dislike science.

(h) Practice in copying diagrams until the student develops a technique of his own.

(i) A check on the inability of students to explain <u>effects</u>

in the light of specific <u>causes</u>.

(j) Interpretation of scientific data in experiments.

(k) The relatively higher rating in objective test questions, hence the need for training in written language work in essay types of answers.

(l) The content of experiments is often well explained in paragraph form, even if the standard form is not adhered to. The question arises: Shall we demand the standard form of experiment report?

3. <u>Indications that insight learning is possible in the field of general science.</u>

The students of the control groups displayed considerable initiative in handling the gestaltic plan of presentation. The most notable feature of the plan was the child's realization of a goal, and of his reasons for movement toward said goal, and the perception of a clear cut task. The disinterested student resembled the chimpanzee in Kohler's experiment; satisfied that the banana will be brought to him, the chimpanzee sits and waits; the student who does not accept a problem-solving challenge will not do well under any plan but merely waits until a teacher is prepared to work on him and bring him his educational meal.

The average student (if one exists) or one of super-normal ability, handles the insight method well. He quickly 'catbhes on' to the pattern method of learning and keeps this pattern to the fore throughout the study. This was the case with the chimpanzee referred to above, who had of necessity to keep his

goal in mind throughout the learning process. It was necessary however, to provide the boxes, the banana, and the 'out-of-reachness' for the chimpanzee to have a problem to solve. So too, in a correspondence course, we must provide the goal, the materials with which to reach this goal, and the problem to solve. The student who shows interest and who can be stimulated to problem attack, performs well in an experimental study.

4. <u>General utility of the technique.</u> -

The outcomes of this investigation should indicate how guidance in correspondence courses and in classroom procedure might be improved. The advantages to the student have been summarized in chapter 5 under the treatment of the student questionnaires.

In the realm of attitudes and of appreciations, measurement of results is impossible in correspondence study work. In the city group it is quite evident that those individuals who received most benefit from the standpoint of appreciations did not make the highest objective score. Certain individuals of the city students who had previously disliked science received a new impetus to their science studies.

With all students there is need of training in accuracy of scientific thinking, science expression, science reasoning and in diagrammatic work.

With a distribution of intelligence, pupil achievement is correspondingly distributed. That is to say, pupils learn

the materials of science (knowledge) as well by the gestaltic-whole method as by the adult-logical-organization-method. For students of distributed intelligences, the attitude toward science is improved by the psychological attack.

Students dislike the detailed writing out of science experiments. They develop an uncertain appreciation of the scientific method from so doing. A labelled record comparable to the scientist's method of recording of an experiment is often sufficient for notebook work. Very careful direction is needed however, in this shorthand technique.

Appreciation of the scientific method comes more readily through the working out of a unit, a problem, or an experiment, than in the detailed writing out of experiment-after-experiment in a notebook.

Thus conclude the <u>general</u> observations and findings of this investigation.

CHAPTER VIII

SUMMARY EVALUATION OF THE EXPERIMENT

1. Suggestions as to major needs. -

(a) An animated correspondence course.

There is need to animate correspondence courses in order to conform with modern, up-to-date techniques and methods. The activity principle is fundamental to all learning. Physical activities such as drawing, experimenting, reporting, recording, must all form a part of correspondence work. No longer must students do the mere 'passive' and silent study work in science; they must read for intelligent appreciation; they must do research work to obtain information; they must solve the consequential problems related to the main theme under study; they must be trained in scientific attitudes; they must use the scientific method; they must be directed in critical thinking; they must be trained in the interpretation of cause and effect relationships; they must be guided in the path of generalized concepts. The use of visual aids, of the sketch and the chart are as essential in learning by correspondence as by the teacher-pupil process. In the design of courses, the work of the artist is as necessary as that of the typist or commentator. Correspondence studies must be made to live, and boys and girls in their endeavor to interpret them must likewise live during their study.

(b) Animated learning in general. - The learning process for the student must be one of vivid experiences with abundant training in mental direction toward the understanding of science relationships. Pupils must develop their powers to establish

"Deweyian" images. It is contended that the gestaltic pattern or methodology will train children in originality of thought, in a better organization of mental concepts and resumés, in more significant residual understandings, in a more purposeful mastery of science skills, in a more thorough-going attitude to the subject content of science, and in an appreciation of the efforts of man to further our comforts and our standard of living.

The use of a laboratory kit by the students and the setting up of experimental activities is an inherent part of the learning process in science. As far as correspondence courses are concerned this phase of the science course must be carefully organized at the correspondence centre as a constituent part of the total framework.

(c) Animated teacher-guidance; - This phase of the correspondence course, with its absence of day-to-day and face-to-face relations between pupils and teacher will ever prove a serious drawback. The isolated student misses entirely such socializing influences as group assembly, prayer, physical training, play, singing, and the like. An animated course, carefully designed by an imaginative director will do much to compensate for the unfortunate lack of emotional socialization in the growth of the isolated student.

In the teacher-pupil situation it is felt that much experimentation in classroom methods still remains to be done. A wide open field exists for the introduction of a gestaltic organization of a science programme.

2. <u>The final criticism of the experiment.</u> -

(a) <u>Favorable conclusions</u>. - An effort has been made in this thesis to indicate how local perceptual experience, close to the child's life, is built up in a conceptualized treatment. The broad conclusions of Chapter VII suggest the need of skilful teaching and of vivid learning situations in <u>all</u> subjects.

(b) <u>Functional value of the thesis</u>. - While the results of the investigation are not so completely conclusive as to state that the gestaltic method of total perspective is the best and only valid method of teaching, there is evidence to show its value for correspondence work and for general classroom performance. Such suggestions as learner-activity, learner-disposition, motivated problem-solving, director-imagination, should prove fruitful to teachers and to correspondence organizers in their educational experimentalism.

(c) <u>Retrospection.</u>-

If the experiment were being repeated with a view to further establishing the tentative conclusions which have been arrived at, certain modifications in procedure now appear to be necessary.

The general nature of the experiment should be altered in order to introduce control groups which would permit of a comparison of the gestaltic method with other special methods.

The results of experiment-tests given to students untrained in the gestaltic technique were not of sufficiently validity from the standpoint of scientific and of statistical

interpretation. This lack of comparative reliability of the experimental findings is a weakness that should be taken into consideration.

A more careful selection of students should have been made. In the case of approximately one-third of the total group, much of the effort in preparing and supplying materials was wasted.

The Otis-self-administering test should be given to the correspondence student in order to correlate intelligence with understanding of the method under trial. Extended investigation into the relationship between these two variables (I.Q., and Achievement) should have been made in order to discover whether the 'flash' or 'insight' method is better or less adapted to the brighter student. Questionnaire answers rather incline to the supposition that the duller student needs special assistance-which is the case in any method of teaching. It would appear that the method under test would need to be enlarged for the student who does not see relationships quickly.

It is felt that the experiment should have been more inclusive of the isolated student type. Only six of the nine lone students completed the two unit studies. It is true that the cost of preparing lessons, charts, diagrams, and of furnishing equipment kits would be a prohibitive factor, but the fact remains that more isolated students were needed in order to make the findings significantly and generally conclusive.

Further investigation is required into student attitudes in relation to the method under test, or to learning generally, before finally conclusive evidence can be furnished as to the

preferability of the gestaltic method over all other methods.

Insight learning demands a clear picture of generalizations and of broad scientific understandings. A repetition of the experiment should make provision to see that such concepts are developed.

It would be unfair to conclude that science appreciations are impossible or less possible under other methods of learning. The evidence obtained in this experiment is insufficiently comparative to arrive at such a finality of interpretation.

Types or methods of science teaching require further investigation than this experiment has afforded. A more thorough analysis of such thinking processes calls for careful statistical survey.

More cases should be examined before such final conclusions as: 'young students do as well under gestalt learning as do older experienced dull students' can be made.

Two units are hardly sufficient in attempting to make such important and far-reaching generalizations as: 'Children do as well, if not better, under gestalt learning'.

Final guarantee that, because of attitude, correspondence students rank higher than non-isolated students, must be held in abeyance. Many inter-related factors are involved in such a hypothesis.

The major items requiring modification in a repetition of the experiment are:

(a) A larger number of cases,

(b) better organization of control methods in order to arrive

at conclusions of value in the field of comparative methodology.

It was probably an error to have included city and town students in the experiment. In a repeat-experiment the student selection should be limited to the correspondence or isolated student. Throughout the investigation it was felt that the comparison of isolated student achievement with city and town members was not sound, since such groups are not really comparable. The setting up of artificially motivated groups in unnatural 'control' or 'guided' situations was not really favorable.

Finally, it should be made clear that the conclusions to this experiment are tentative and subject to modification with the discovery of more informational data. Such is the spirit of scientific research. The study is submitted as a contribution in the field of educational method.

APPENDIX 1

Preliminary Contact and Orientation of the Student

APPENDIX I: Preliminary Contact and Orientation of Student.

THE INTRODUCTORY LETTER TO ALL STUDENTS

My dear Student:

This is my introduction to you and is for the purpose of getting acquainted. I want to know you quite well so as to start you thinking about science the way I think about it. It is not the only way to study your science but I do wish to try out my method and see if you like it.

My name is:

(Mr.) A.L. Doucette,

My address is:

1529-12th Avenue West,
Calgary, Alberta.

I want you to write and ask me questions you wish to know about our work together. I want you to send me the exercises you do, also the reports of your experiments, and especially how you are finding the work as you do your study. I shall want you to tell me if you find it easier to study your text after you have done the guidance work with me first. I SHALL ESPECIALLY WISH YOU TO TELL ME WHAT YOU THINK OF THE WHOLE PLAN OF STUDY WHICH I HAVE OUTLINED FOR YOU.
I wonder if your science will be more fun if you work it out the way my lesson materials suggest. I wonder if you will find it easier to recall the work you have done in the 'bird's-eye-view' method I have proposed.

I shall send you three lots of data:

1. An introductory bit of material which you are to read. At the same time I shall send a "Preliminary Laboratory Manual".

2. An outline of a study on <u>HEAT</u>.

A "Laboratory Manual" to accompany the study of heat.

3. An outline of a study on <u>LIGHT</u>.

A "Laboratory Manual" to accompany the study of light.

This is all for now, and <u>GOOD LUCK</u>.

Yours sincerely,.................
Your friend.

ORIENTATION TO THE STUDY

My Dear Correspondence Student, and Students Working Alone:

I am going to write to you as if I had known you for a long time because I wish to establish a very personal relation with you right at the start.

Even though you cannot see me from day to day in the way that boys and girls in school see their teacher, I want you to feel that we are friends and that I am your teacher and guide during our two studies together.

You have already started to work in your General Science Course and I wonder if you have a clear idea of what it is all about. I do hope that as you proceed in your study of science you will soon realize what a delightfully wonderful study it is. The reason it is so wonderful is that it deals with you, with your folks, and with all the people in this world of ours; howwe all live and have managed to make the earth such a grand place in which to work and live.

Have you really wondered about the extent of your science work for this year? Have you realized that science is: A way of thinking of your "whereabouts", and also a systematic organization of everything that exists and happens in this "where-

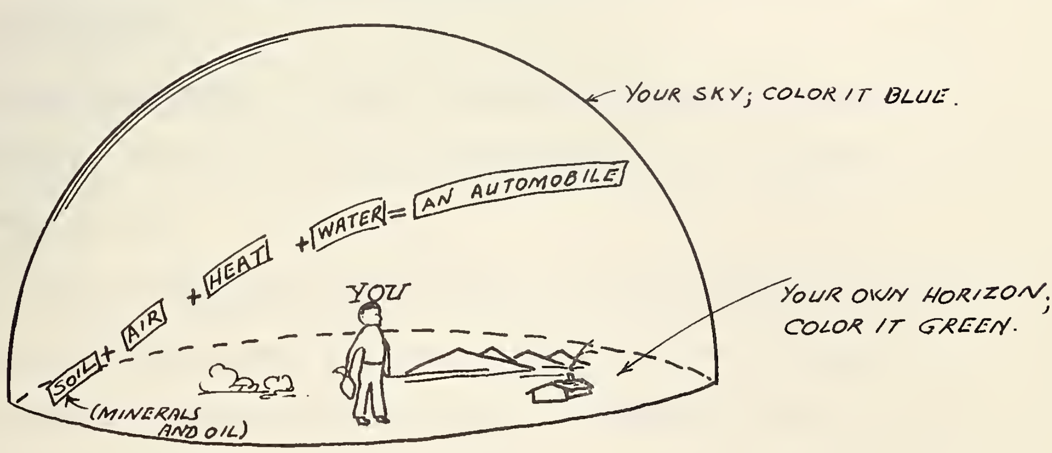
abouts"?

Do you view your locality as a bit of the vast orderly world in which man lives? Do you realize that before the great inventions of our time were completed, some of which are on <u>your</u> farm or in <u>your</u> home, that such inventions did not exist at all at one time? And that the scientists often had no more with which to work than the things you can find in your own district?

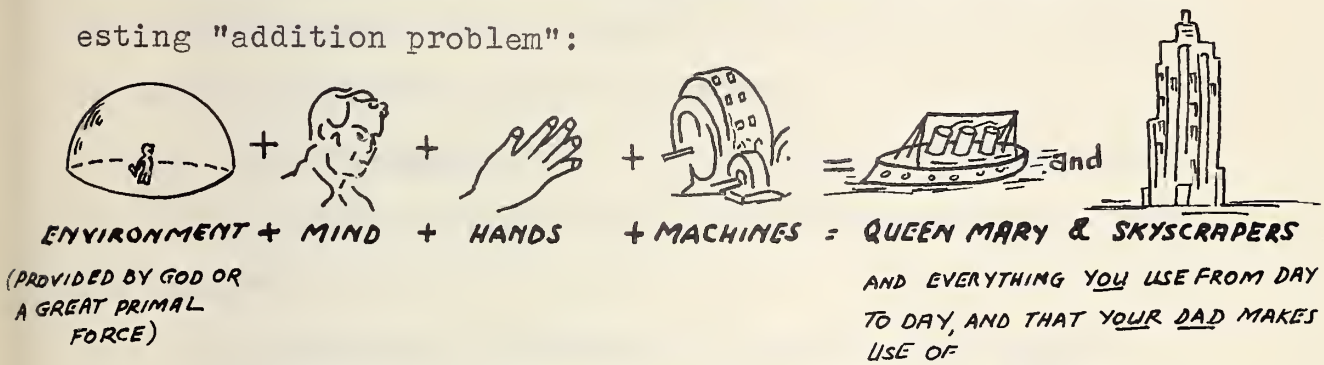
Do you realize that science deals with the tiniest, invisible things all about <u>you</u>----germs and microbes; and also with the greatest (also invisible) things that are far, far, away----the stars, the heavens and space?

Do you know that all around <u>you</u> in <u>your</u> locality are many of the materials that have made scientific progress possible as shown by this picture?

YOUR ENVIRONMENT



Can you understand that your 'environment' is everything you see, touch, hear, taste, smell, i.e. everything we identify with our senses. Let me give you a very interesting "addition problem":



Now don't you see what a wonderful being man is? how wonderful your brain is? how wonderful that we have fingers and not a flat stub or hoof for a hand? and will you do your best always to keep your brain healthy, contented and fresh by clean and sensible living?

And will you not wish to know all about this world you live in, because many many men and women have done a great deal for you before your arrival on the scene? At one time these men and women were mere boys and girls like you, and when they were young they did not know a great deal about science.

Now by this time I think you have begun to wonder considerably, for it is real scientific fun to wonder. Let us wonder on.

(1) Your eyes are reading what I have written to you. Do you think any man will ever be able to make an eye---- that wonderful organ that has made it possible for you to know me even though we haven't met?

(2) Do you think we will ever be able to "fly" to another planet, or to the moon, or to the stars?

(3) You know that an apple <u>drops</u> from a tree. That is rather strange when you come to think about it, but it is rather convenient, don't you think?

(4) But the <u>moon</u> doesn't seem to drop or "flop" about foolishly in the heavens, does it; rather convenient, don't you think?

(5) And do you ever wonder if there is any <u>end</u> or limit to the heavens or to space? And do you think any man will ever be able to find out?

(6) Now, do you not think this world is a grand subject about which to think?

(7) Now just one more thought: Suppose the book on your table were split in two, the half in two again, and so on, until a part became so small that you could just see it; and then, with a highly powerful microscope you split this piece <u>five thousand</u> times more. I wonder what the tiniest piece would look like and whether it would remain still or not.

And now I have begun to know you. I wish you to wonder at those things we see about us everyday, but tend to take for granted.

I wish to draw a picture for you to show you at a glance all that your year's science course is about.

It is about <u>you</u>, <u>your</u> home, <u>your</u> farm, <u>your</u> town, <u>your</u> community, and about all other communities you cannot see but which are linked up with your own community in one way or another.

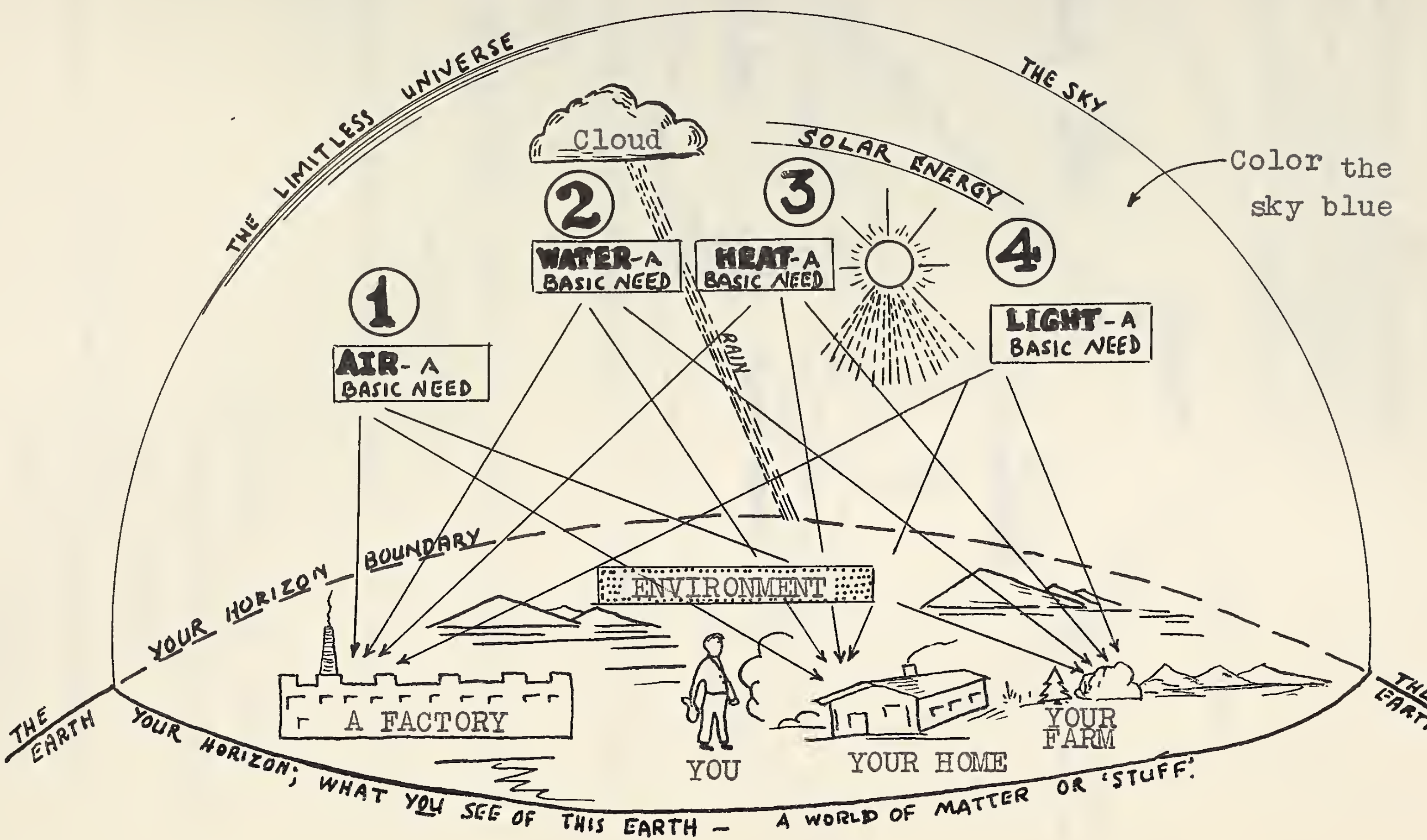
A very interesting way to picture things in your 'mind's-eye' is to think of them as large '<u>wholes</u>' whereby you can see them all at once, at a glance. As you look about your room you see several things all together. The lamp you study by, is a lamp in relation to the table it is on. We never see things all alone, separate and distinct from other things nearby, so that even in our science we should try to view things in relation to each other. For instance we cannot think of water apart from the earth, the sky and people. Air too is part of the earth, and part of us, and part of all plant or animal life; man uses air for a great many purposes and air helps man to do his work in many ways.

And so we shall be examining studies and diagrams of <u>large wholes</u> which will help us to view our work at the start and to sum up our ideas at the end. Please don't forget this all through our work.

I should be very glad to know if you enjoy this way of summing up in your <u>mind</u>, the studies we take together. Tell me truthfully however, if you do not.

AN ENVIRONMENT PICTURE

OUR GRADE IX STUDY FOR THE FULL YEAR



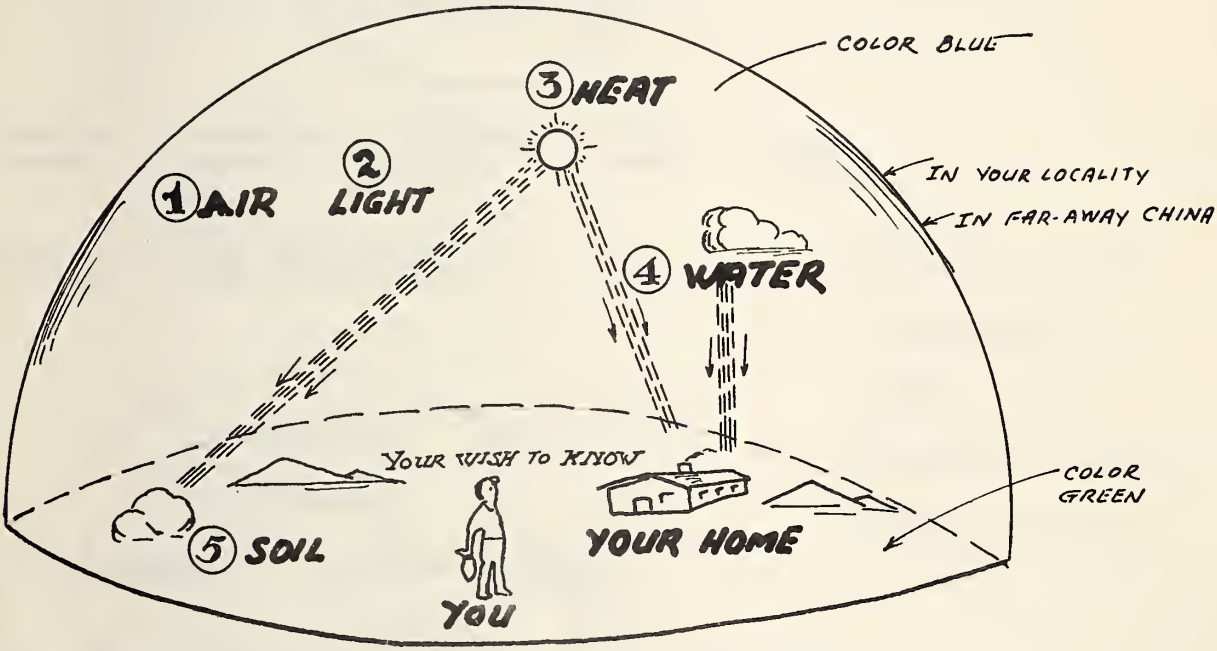
Color the factory red, your home yellow (roof gray), horizon locality green, arrow lines red. This will make a very attractive sketch.

THE GRADE IX COURSE

An Overview or Whole-picture

Followed by smaller wholes or

"sub-wholes" of lesser parts.



NOW LET US SUM UP THE "PART-STUDIES" IN A SORT OF "MOVIE-STRIP" TREATMENT.

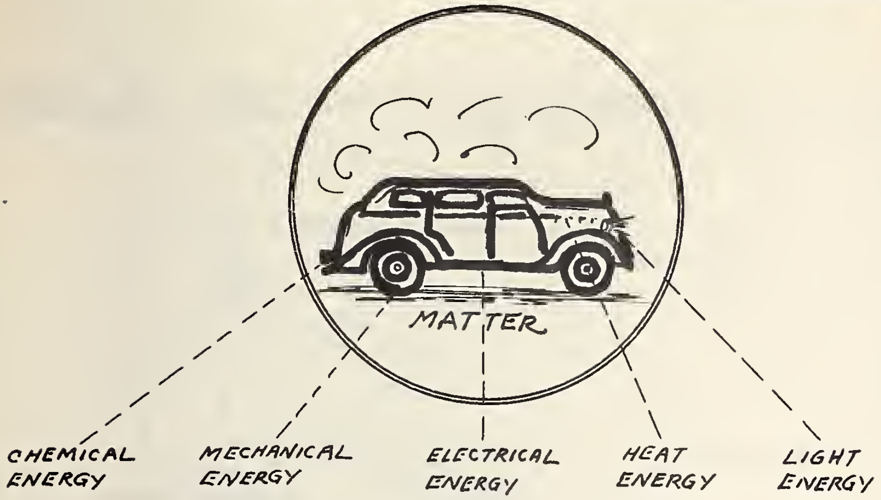
STUDY 1. THE ENVIRONMENT (Earth, sky, water, village, city machinery etc.)

"Environs" (round about) - Factors of the environment.

- To know these factors.
- How to experiment with these factors.

-Nature of the environment-Matter) -both found in
-Energy) automobiles.

MATTER AND ENERGY IN AN AUTOMOBILE



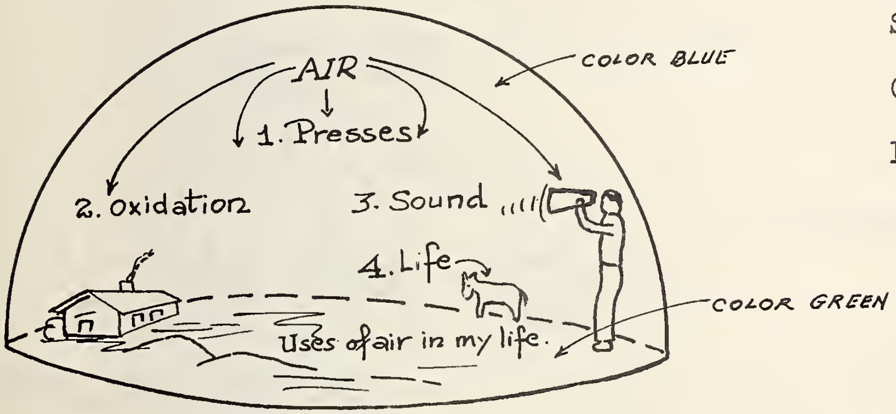
STUDY II - AIR AND ITS WORK ....Pressure of Air.

Uses of air.

Sound in air.

Oxidation in air.

Life in air.

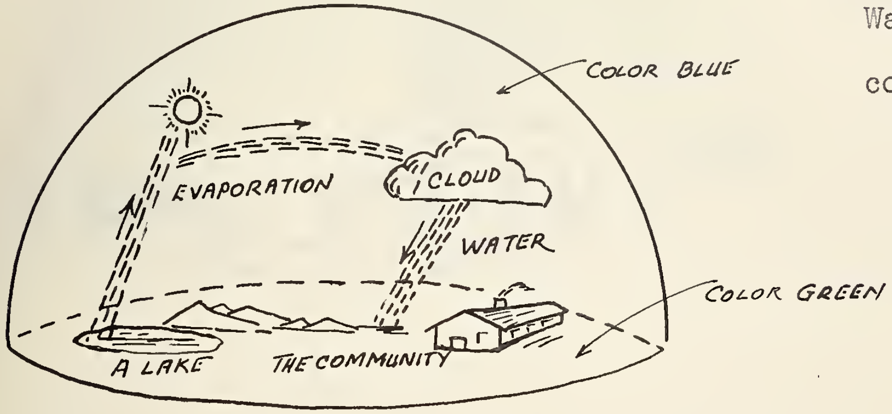


STUDY III - WATER ....Pressure.

Uses in the home.

Refrigeration.

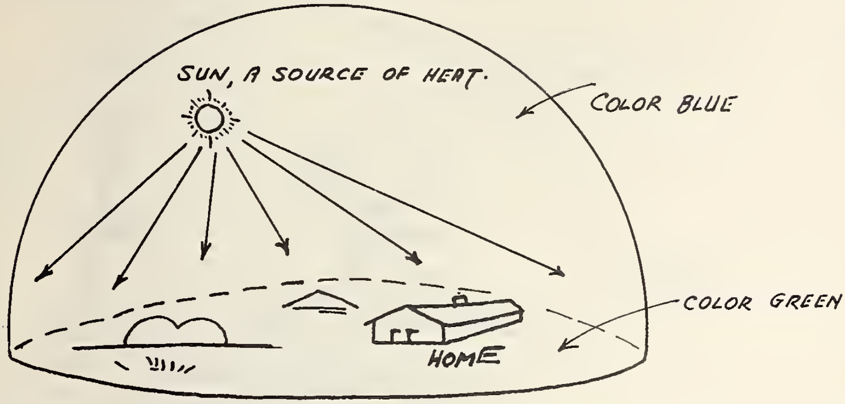
Water in our community.



STUDY IV - HEAT (ONE OF OUR STUDIES)..........Sources.

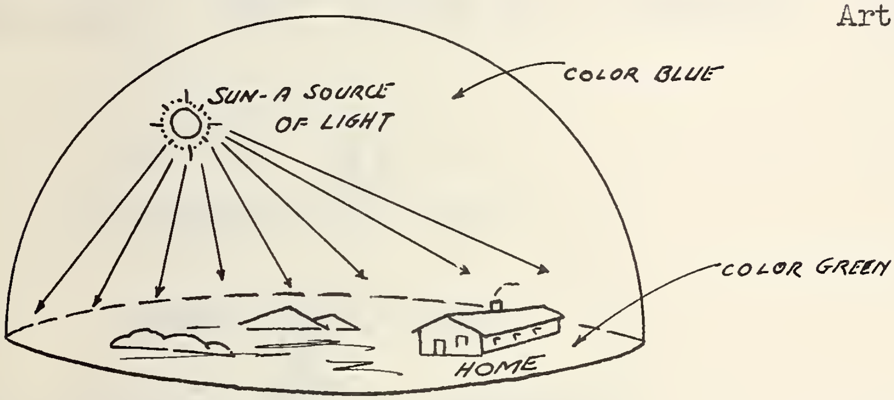
Physical effects.

Warming our homes.



STUDY V - LIGHT (OUR SECOND STUDY)...........Source.

Artificial light.



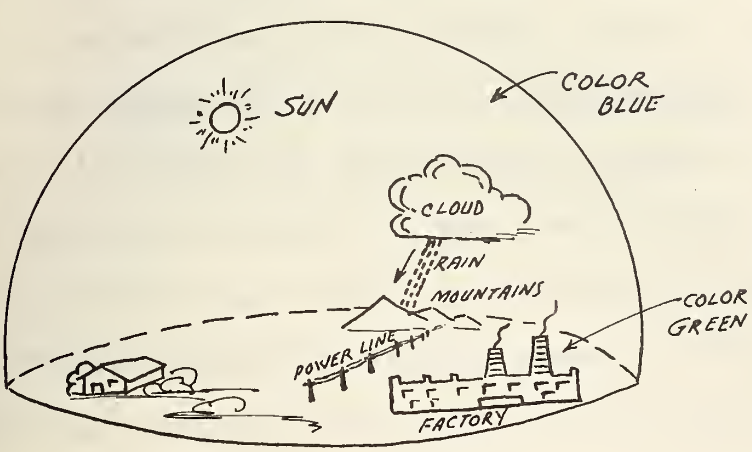
STUDY VI - INDUSTRY..........................Source of energy.

Magnets.

Heat and Power

Gas Engines.

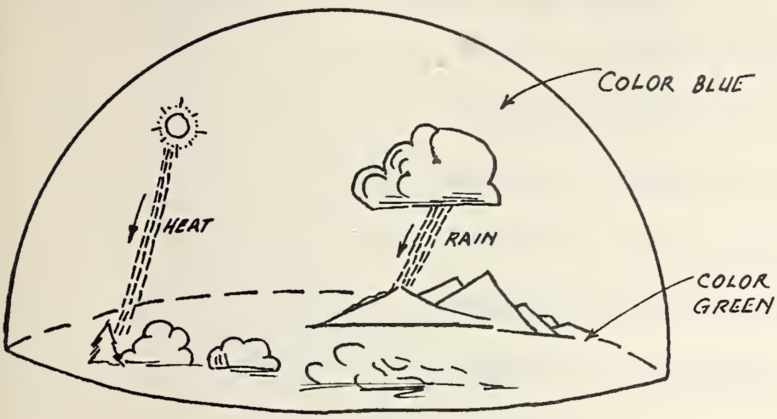
Water Power.



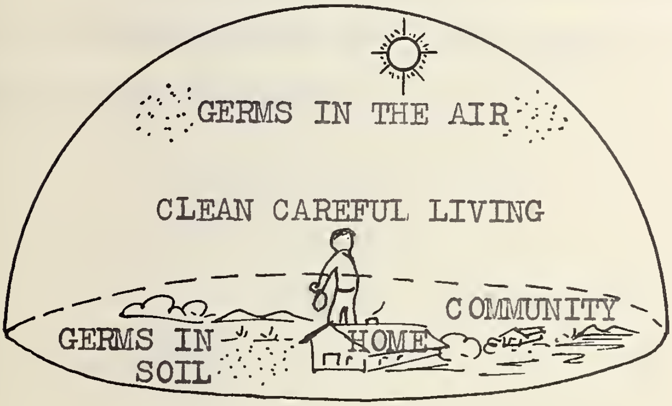
STUDY VII - SOLAR ENERGY........................Source, direct and indirect.

Living Plant.

Plant Cycle.



STUDY VIII - SAFETY OF SELF AND OF COMMUNITY. - Micro-organisms.



You will begin to see what I mean by seeing things as a large whole and the parts as sub-wholes. Do you find it easy to picture the whole year's course and also the different studies that make up the year's work? Let us list the eight studies and see if by closing your eyes you can see the "WHOLE-GRADE-IX" diagram summary, as a unit, and possibly the smaller units that have been sketched for you.

THE GRADE IX PROGRAMME IN SCIENCE:

Study 1: The Environment.

Study 2: Air and its work.

Study 3: Water and its work.

Study 4: Heat and its work.

Study 5: Light and its work.

Study 6: Industry.

Study 7: Solar energy and its work.

Study 8: Safety of self and of community.

If you cannot see the "mind-pictures" clearly copy them in your note book and color them as directed. Does it help to make them clearer?

I wish to talk to you a bit more before we go on with a special study. You are a person; one of many millions who have been born to know about this world of ours, and what man can and has done with it thus far. The word 'Science' comes from a Latin word 'Scire' <u>to know</u>, or 'Scientia', <u>knowledge</u>. Everybody seems to want to know what things are, why they work, and what they are good for. If you are a girl you will wish to know how the floor-sweeper works. You will <u>have</u> to know, for someday you may have to clean the inside of it. If you are a boy you will want to know how a farm pump or a tractor works for you too may have to fix these machines someday. Knowledge is not the memory of a great mass of facts but is the <u>interpretation</u> of facts we see and read about. Science aims to help us to interpret facts.

Really we are happy when we know a great deal, but we can never know everything. This is especially true today when the world of science is progressing so rapidly and in so complicated a manner. Certainly we can never hope to read all the books in science that are being published in one year in these times.

Your real purpose in science is to know the 'gist' of things. That is to say, you will read a great deal in your science books but you won't remember everything. You will remember a <u>general impression</u> only and possibly the facts connected with the general idea. You may find out that the sun is 93,000,000 miles from the earth but you may forget the number. If however you figure out how long it would take you to walk that far at four miles per hour, you will never forget that the sun is a

tremendous distance away. I wonder if you, your father, and your grandfather, together (one after another) could have walked to the sun in the course of the three life-times? Do you think it is waste time to figure out this walking problem? I just wonder if you do? If you don't, I am sure you will like science from this day on.

And don't you think that it is wonderful that this sun, so far away, can make a car fender so hot in summer that you can't touch it? Now, aren't you beginning to wonder again? Do you think you could live on the sun? I wonder why it doesn't burn right up? Now I know you are beginning to shiver at such thoughts!!! Why?

I am sorry I could not have started your science work with you at the first of the year. However, just because I am sending my letters to several other boys and girls, and because you will not all be working at the same place in your correspondence work, or in your school work, I am going to ask you to work with me on two special Grade IX studies which I hope you will enjoy. It will help you when you come to study them in your regular work, or you may be able to get permission to study the two units with me instead of with the correspondence department. We shall see. One study is on HEAT and the other is on LIGHT. I shall only be able to work with you on these two studies.

We shall work with your text book in science, with my letters and materials to you, with my diagrams, and your notebook. I shall send you also a small kit of "Experiment

Materials".

Now let us discuss the picture of your Grade IX science course on page 85; examine it carefully because it sums up the science studies for the year. First of all you know what your horizon is; if you do not, look up the word in a dictionary, and then go out-of-door and look at it, all around-north, east, south and west.

ON this horizon are soil and crops.

UNDER this horizon, inside the earth, are gas, oil, coal and minerals.

ABOVE this horizon are air, clouds (water), sun (heat and light).

This is what you will study about this year in science. It comprises our NATURAL ENVIRONMENT and from it man makes an ARTIFICIAL ENVIRONMENT. (Look up these two words in your dictionary and in your science text and write down in your notebook your own definition of them).

FILL OUT THE LIST BELOW IN YOUR NOTEBOOK

NATURAL ENVIRONMENT MATERIALS	ARTIFICIAL ENVIRONMENT MATERIALS
I. Rain	I. A Binder
2. Clouds	2. A pencil
3. Trees.	3. A church
4. Frogs	4. Marquis Wheat
5.	5. Trains, ships
6.	6. ......
7.	7. ......
8.	8. ......
9.	9. ......

OUR ENVIRONMENT PICTURE AGAIN:

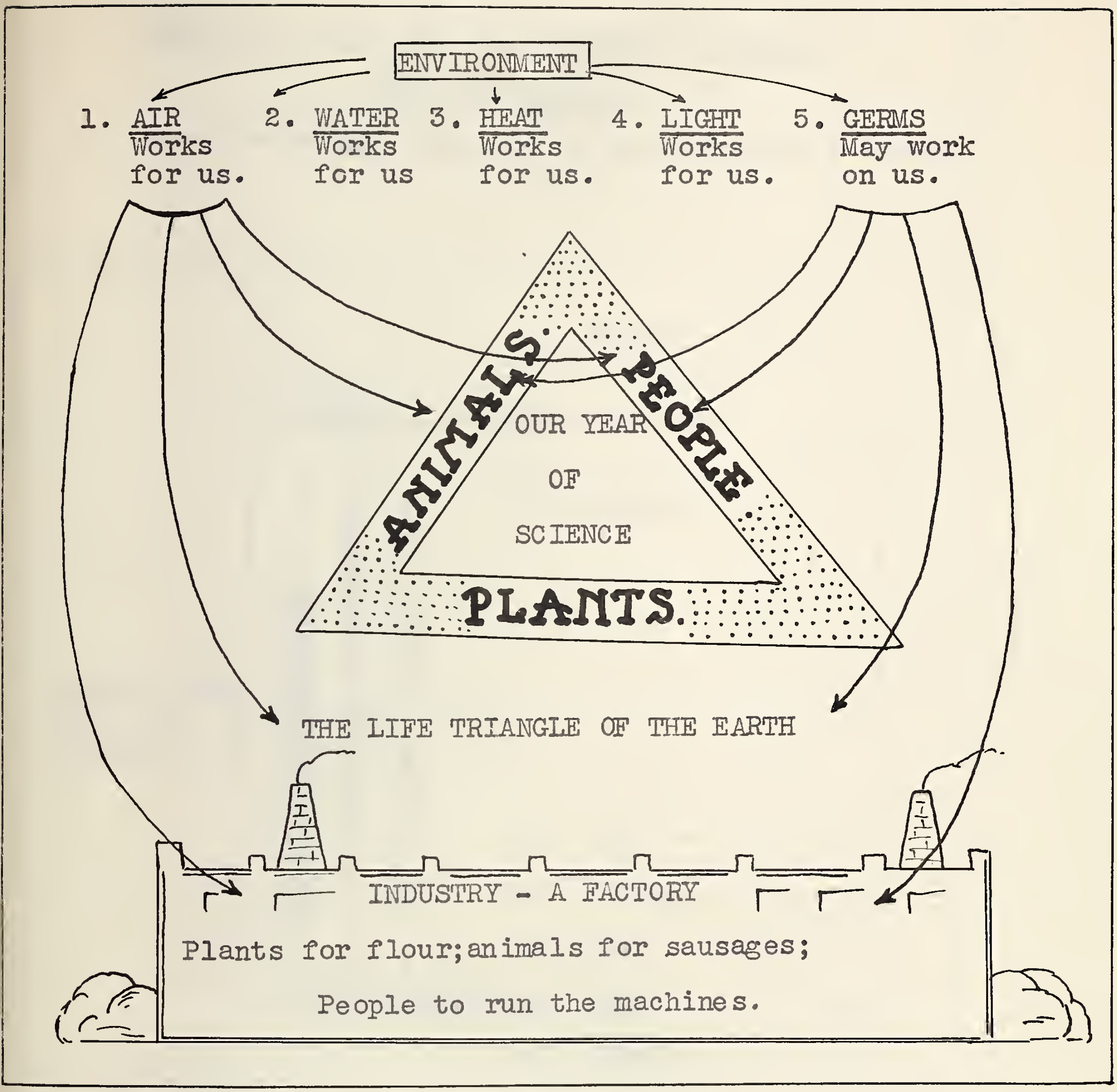
Now look at the "horizon-sky" picture on page 85 again and see in your "mind's eye" what the diagram contains. Then imagine yourself outdoor, thinking of the different parts of our year's study.

Look in the sky and see if you can discover the needs of life (plants, animals, and people).

Look at the factory; it too requires these needs or 'sky-aids'. You will see by now that our year's study is about the environment. Isn't it rather easy now to keep in mind your whole year's study in this picture-summary way? Can you close your eyes and 'see' the parts of the horizon-picture that affect every boy and girl in the world? every boy and girl of years gone by? and every boy and girl yet to live?

Such is the study of our environment. You will learn that great thinkers and inventors have in the past taken these crude gifts of nature and done wonderful things with them. Do you realize that everything in your house and on your dad's farm came out of the ground or out of the air? You may not realize this now but you will later.

Let us draw another picture of your year's work in science in a different way. I wonder which one you will like best. If you don't like either one at all I want you to tell me, please. I will be very happy to know what you think.

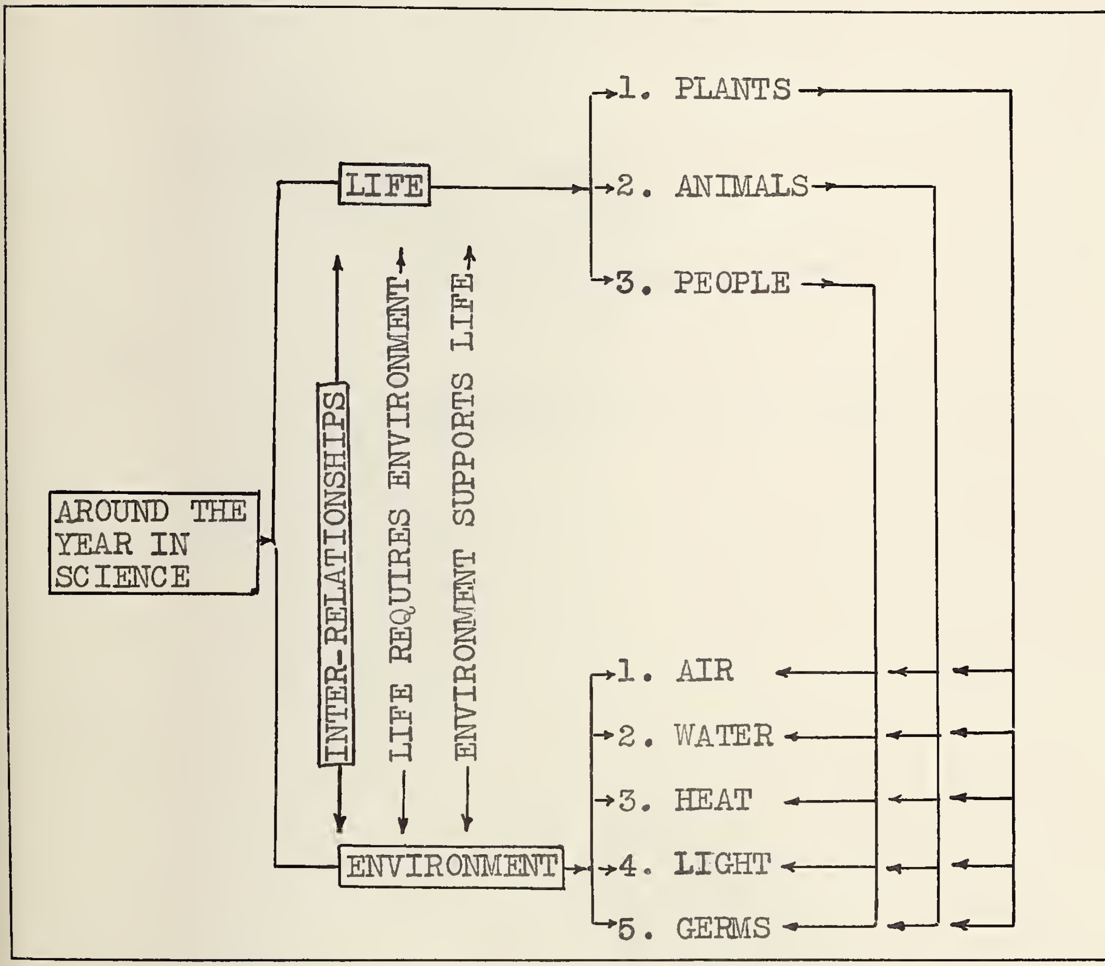


Study this diagram carefully and copy in your notebook.

I have only shown arrow-lines from "AIR" and "GERMS" but you can picture the other lines as coming from WATER, HEAT and LIGHT also.

HERE IS A THIRD WAY TO PICTURE THE YEAR'S
WOR
WORK IN SCIENCE.

(Study carefully and copy in your science notebook).



Let us suppose we have one part of our environment taken away from us. In your notebook write a short composition for me on the subject:

"IF WATER WERE SUDDENLY REMOVED FROM THE EARTH".

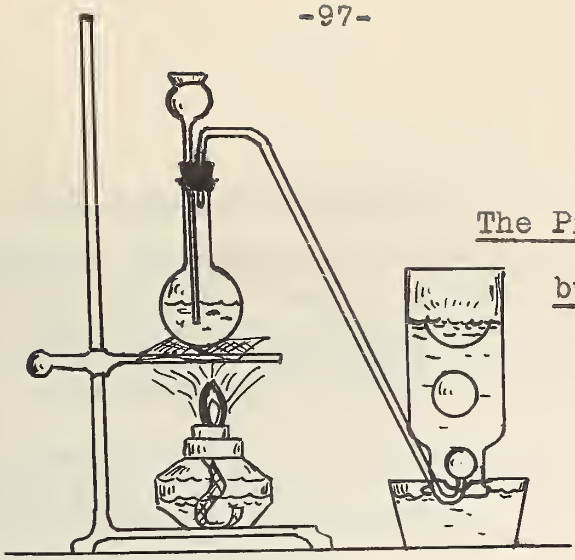
Now that we have a bird's-eye view (you might like to call it an "over-view") of what your year's work is about, let us proceed to our first study, a Unit on Heat.

APPENDIX 2

THE PRELIMINARY MANUAL

for

building your laboratory.



APPENDIX 2

The Preliminary Manual for building your laboratory.

A PRELIMINARY MANUAL
OF
LABORATORY INSTRUCTIONS

To be read and completed before carrying out any experiment work, on Heat and Light.

Name____________________

THE HOME EXPERIMENTER

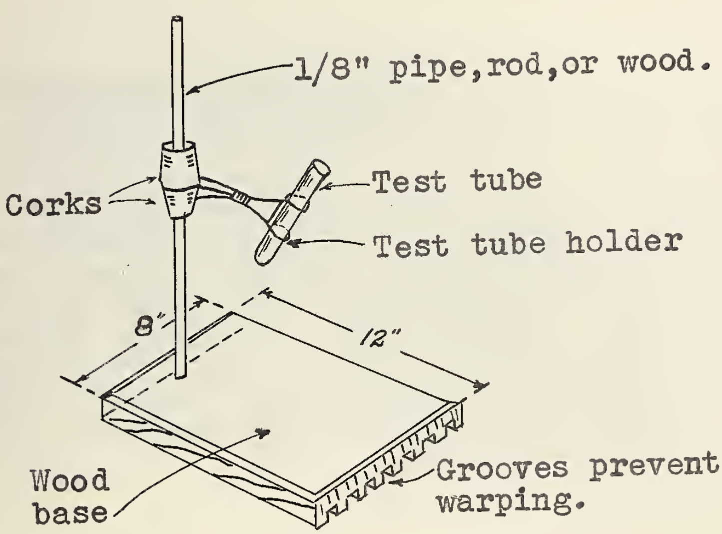
To experiment effectively at home, you will need a chemical bench, even if it is nothing more than a set of apple boxes, nailed together. Experiments are often a bit messy and test tubes often spill over when you are heating them.

You will really need a place where you can work and play at your own convenience, and without danger to household furnishings.

1. Making a support stand.

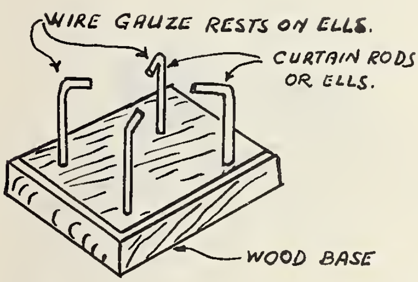
You will very often have to heat test-tubes, beakers, or flasks. This is awkward unless you have some convenient way to hold the vessels you are heating. You can make a support easily as shown below. A wood or iron rod is mounted snugly in a hole drilled in a wooden baseboard. The rod should be about twenty inches long and about two inches from the back of the board.

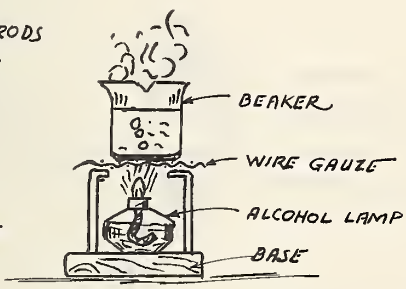
Test tubes are held by having a clamp (which you can make out of heavy hay-wire) fitted between two large corks, bored to slide up and down the rod,



2. <u>To make a useful stand for heating beakers and flasks.</u>

Take a piece of wood about six or eight inches square and in it screw four ell-shaped hooks such as those used to support curtain rods. Old curtain rods may be used. Bend them and make them high enough so that, when the heating device (lamp) is placed on the stand, the flame spreads out on the wire gauze. The wire gauze consists of a piece of old screen mesh about four inches square, and serves to protect the glassware from breaking.





3. <u>To make an alcohol lamp.</u>

Candles are not satisfactory for science experiments as they do not give enough heat and are very sooty.

You can make an alcohol lamp as follows: Take a lotion bottle of thick glass, with screw top and bakelite cover. Score or mark the neck below the threads with a file and tie a string around the filed groove. Pour alcohol carefully on the string and then light with a match. Thrust the neck into a bucket of water and at the same time tap the neck with a

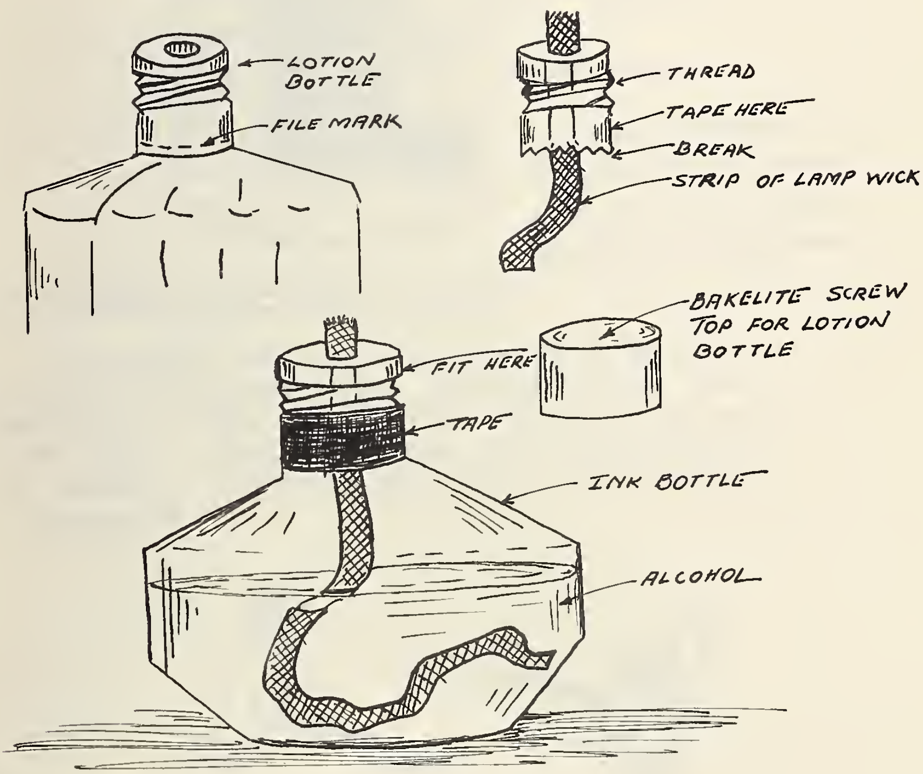
hammer handle. It should break off at the string.

Cut a strip from a lamp wick and with a twisting motion feed it through the hole of the bottle neck.

Bind the neck below the thread with bicycle tape, or adhesive tape, using enough so that the lotion bottle neck fits into the neck of an empty ink-bottle. Use a piece of wick long enough so that it will coil up in the alcohol.

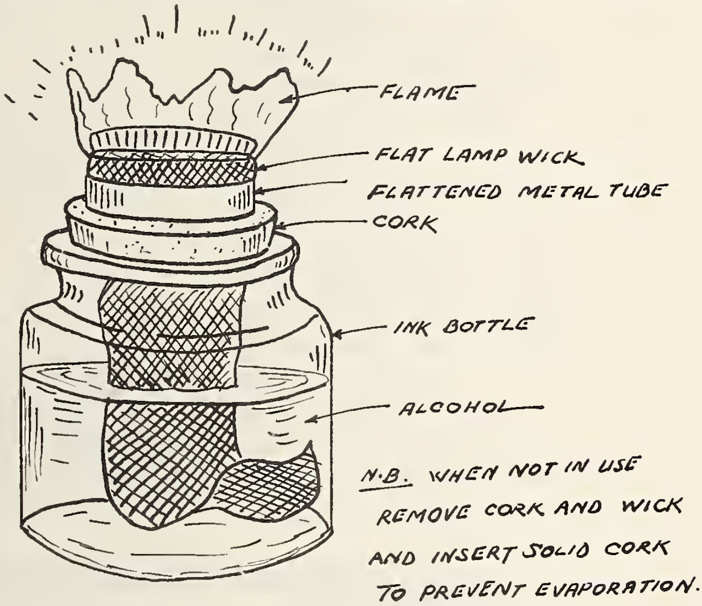
When the lamp is not in use keep the cap on the top, otherwise the alcohol rises in the wick and evaporates away.

The alcohol lamp does not form any soot.



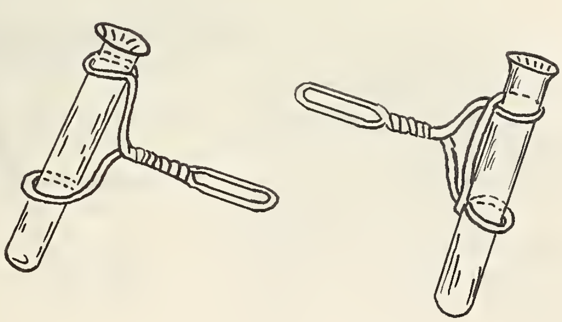
4. Another kind of alcohol lamp.

You can make an alcohol lamp to fit the wide cotton lamp wicks sold for oil lamps if you flatten a metal tube and fit it through a slot cut into a cork. Insert the cork in an ink bottle. Try to plan a snugly fitting cover.

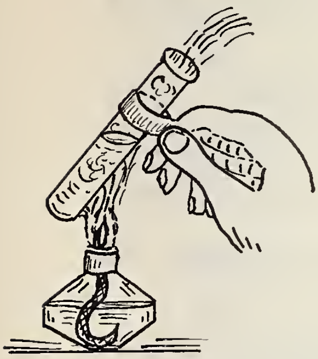


5. To make test-tube holders.

The most simple and useful piece of glassware in your home laboratory is the test-tube. You will need a test-tube holder so that escaping steam will not burn your hands. You can make wire holders out of hay-wire.



6. Holding test-tubes while heating.



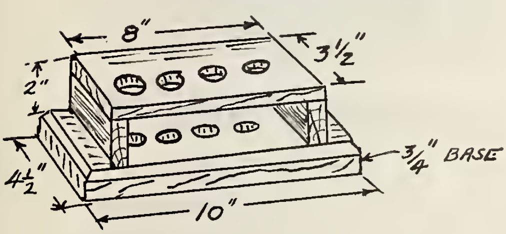
You can use a strip of heavy paper as a test-tube holder but this is not as good as the wire holder.

Always hold the test-tube at a slant and bring it to the flame gradually.

If you use the paper holder fold the paper into a collar around the top. Hold the tube as shown and turn it so as to heat all sides evenly.

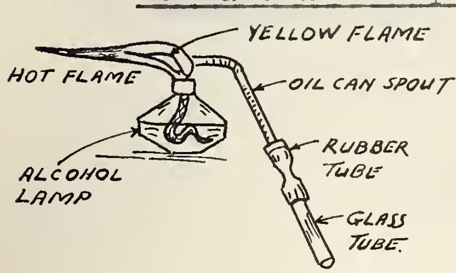
Don't let the flame strike the glass at or above the level of the liquid as the tube is likely to crack at that point.

7. To make a simple test-tube rack.



The diagram shows clearly how to make a simple test-tube stand.

8. To make a blow-pipe.



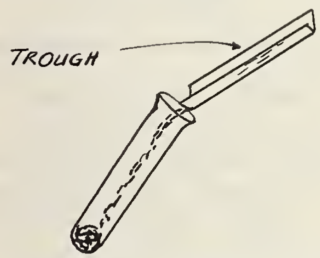
Use the curved spout of a five-cent oil can. The spout is lengthened by connecting the spout to a piece of glass tubing by means of a short rubber tube.

9. <u>To insert glass tubing in a cork.</u>

Wet the tubing and <u>also</u> the hole in the cork. Rotate the cork back and forth while you insert it. Do not <u>push</u> the tube straight through the cork for the glass tubing may break and cut your hand.

10. <u>Putting powder or chemicals in test tubes.</u>

Cut a piece of stiff glazed paper an inch longer than the test-tube and a little wider than the mouth of the tube. Fold the paper lengthwise along the middle to form a trough.



Spread the powder along the trough and shake lightly so the powder enters the tube.

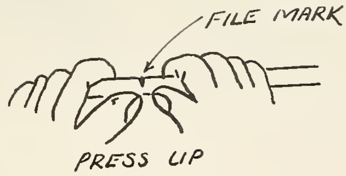
11. <u>Pouring waste acids in sinks or metal containers</u>

Fill the sink or container with water to dilute the acid and thus prevent injury to the sink and water pipes.

12. <u>Heating beakers or flasks.</u>

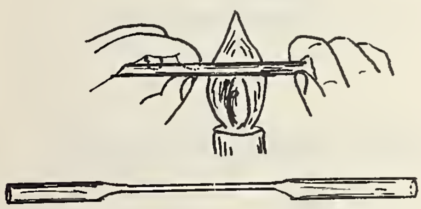
The beaker or flask must rest on wire gauze and is heated gradually. Do not let the liquid in the beaker or flask fall low, nor heat above the level of the liquid.

13. <u>To break a piece of glass tubing.</u>



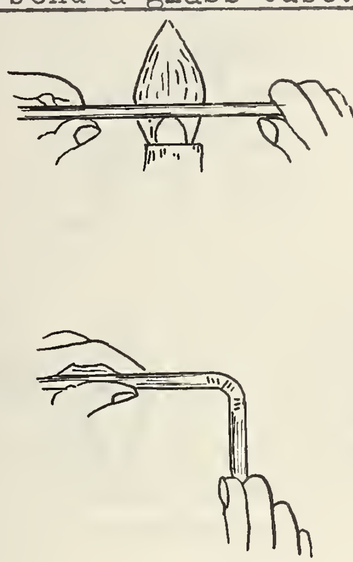
Make a scratch on one side of the glass with one stroke of the edge of a triangular file. Place the hands as shown at the bottom of the previous page, with the thumbs opposite the scratch. Bend the glass toward the thumbs.

14. To make a jet or pointed glass tube.



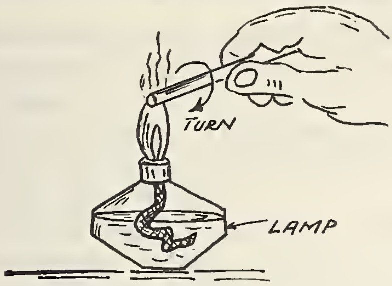
Hold the tubing above the inner cone of the flame as shown and rotate the tubing constantly until it is soft. Remove the tubing and draw the ends apart, slowly first and then quickly. It will stretch as shown. With a file, cut off each part to leave an inch of "drawn-out-part" on each tube.

15. To bend a glass tube.



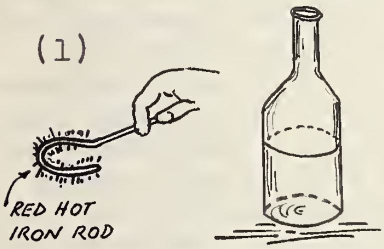
Hold the glass above the dark part of the flame and rotate till soft enough to bend to the angle desired. Keep the bend in one plane without any twists.

16. <u>To close end of tubing.</u>



17. <u>To cut Bottles</u> -Three ways.

(1)

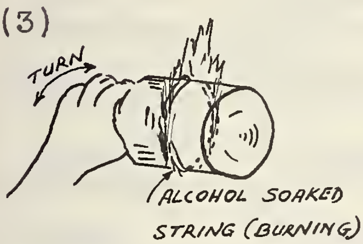


File mark around whole bottle. Touch file mark with red hot rod to start crack. If no crack starts, remove rod and add few drops cold water.

(2)

A few drops of water help, as above.

(3)



When flame goes out, place the bottle under cold water and tap with a hammer handle.

18. <u>To make an experiment table or bench.</u>

Procure four apple boxes and nail them together as shown below. Instal six short legs.

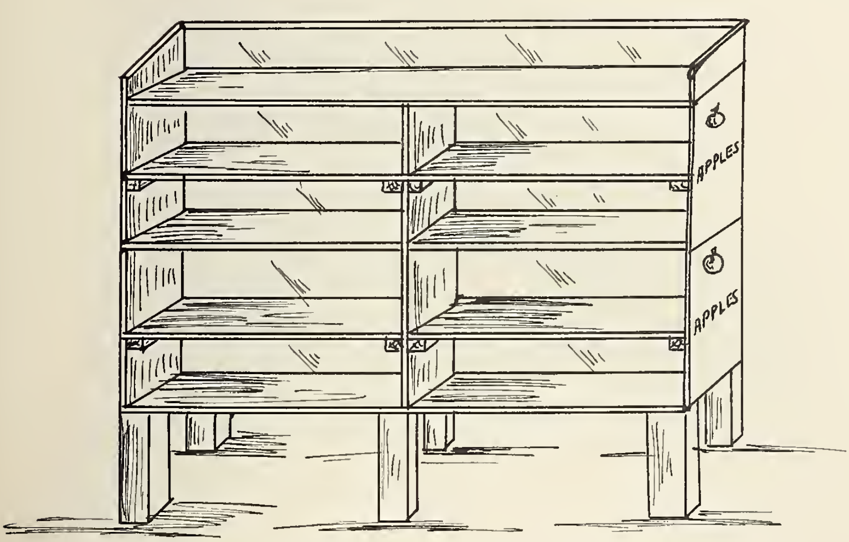
Set in four shelves as shown.

Nail a back strip and two side-strips on the top.

If you wish you may keep the front covered with a bit of cretonne. Cover the top with oil-cloth. You may keep your science books on one of the shelves.

In order to avoid messing up the house do all your experiment work on the home-made science work bench.

As you obtain old bits of science material like old car coils, flash light batteries, or glassware of any kind, keep all your materials together in your science laboratory. This is what the real scientists do. Some of them started in a simple way just as you are doing and had their work bench in old barns.



—A LABORATORY TABLE—

APPENDIX 3.

A unit study on HEAT

APPENDIX 3. A Unit Study on HEAT

Laboratory Materials.

```
A-Alcohol         (keep corked)
  Alcohol lamp    (home-made)
  Apple boxes     (four)
B-Beakers         (2)
  Blow-pipe       (home-made)
  Bottles         (ink) (2)
  Bottles         (Lotion) (& Cover) (2)
  Bottles         (Old medicine) (2)
  Bucket
C-Candles         (2)
  Corks-1-hole    (2)
    "   2-hole    (2)
    "    -Plain   (2)
  Curtain rods    (Old) (2)
F-File (small triangular) (1)
L-Labels          (for bottles) (12)
  lumber          (old pieces of boxes etc)
M-Matches
N-Nails.
O-Oil can spout (old)
R-Rubber tubing (2" piece)
                (8" piece)
S-Screws
 -Stoppers-Rubber (1-hole) (2)
     "       "    (2-hole) (2)
     "       "    (plain ) (2)
 -String
T-Tape, Bicycle
  Test Tubes   (2)
  Test Tubes Clamps (home-made) (2)
  Test-Tube rack (home-made)
  Tubing, Glass (two 1' lengths)
W-Water
 -Wick, lamp.   (1)
 -Wire gauze (old screening) (2-4"x4")
```

....

N.B. Keep materials in order on work bench shelves. Keep bottles labelled.

OUR PURPOSES IN MAKING THIS STUDY

1. To keep our illustrations close to your home and to you.
2. To do a few simple home experiments by yourself.
3. To try to gather a few pictures on this topic.
4. To become impressed with the wonders of your natural surroundings.
5. To appreciate the science of heat and of nature-wonders, by means of sketches.
6. To fit our study into your locality and then to proceed farther afield, thus extending your understanding of the study to distant parts of the world.
7. To become accustomed to viewing the study as a "large-whole" and then to sub-divide it into smaller "sub-wholes".
8. To answer a few questions about the study.
9. To write a few reports on your own experimentation.
10. To keep a notebook record of the work you do.
11. To keep a scrapbook of illustrations pertinent to the study.
12. To follow text-book readings in order to enrich your understanding of the topic.

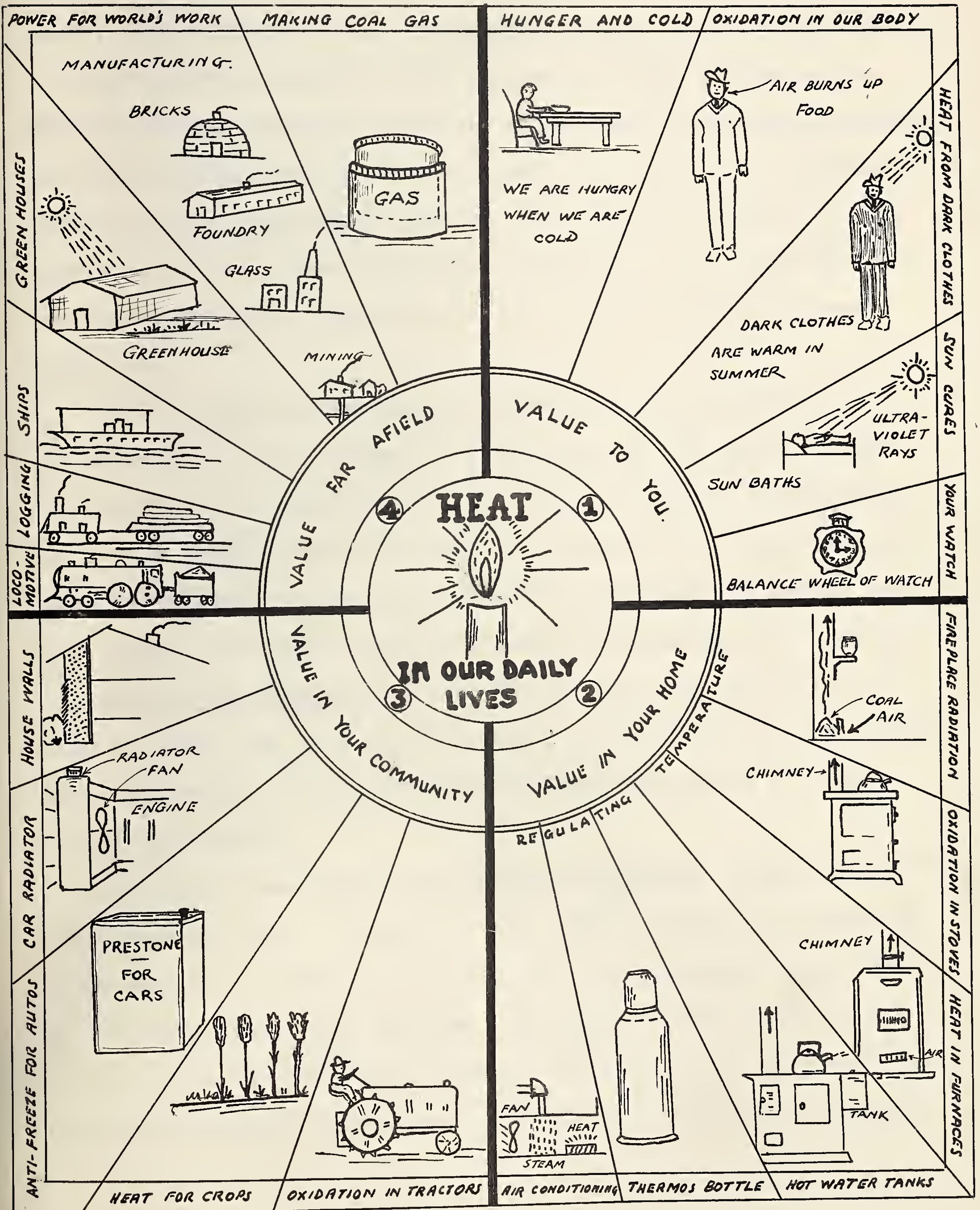
Do not try to memorize these aims or purposes but return to them after the study is completed and see if the full list has been accomplished.

TIME FOR THE UNIT STUDY:

The study should take from three weeks to a month, but you may be able to complete the work sooner.

HEAT AND IT'S WORK

THE OVERVIEW IDEA



The overview diagram on page 109 entitled "Heat and it's Work" shows you a full study of the significance of heat to us in our daily lives and also to everyone in this world of ours. You will note that it applies mostly to the progressive and up-to-date countries like Alberta, Canada, Britain, the United States and many countries of Europe. The Eskimo peoples and the tropical natives do not share all our modern comforts. People in the temperate climates have controlled heat in such a way that their homeland is far different in its comforts and enjoyment than that experienced by the Red Indians many many years ago.

It is very interesting to study this diagram and to try to picture our "Heat Study" all-at-once, on one page. Keep this picture in your mind's eye during the study, thinking of it as the "whole study of heat". At the end of the study turn back to it again and see if you will understand it better than you do now. We shall call this method of imagining the study the "METHOD OF WHOLES". Do you find it easy or difficult to keep in mind? Is it easy to recall, or to picture in your mind, after the study is complete? I shall ask you again when we finish our study.

You have been using the "METHOD OF WHOLES" very often in your everyday life. When you look down the road at a wagon or a car you do not only see the car but you see many other things at the same time. You may see a telephone line, a neighbor's house, a cow in the field, someone walking on the road and you immediately form a 'mind's-eye picture' of the car in relation

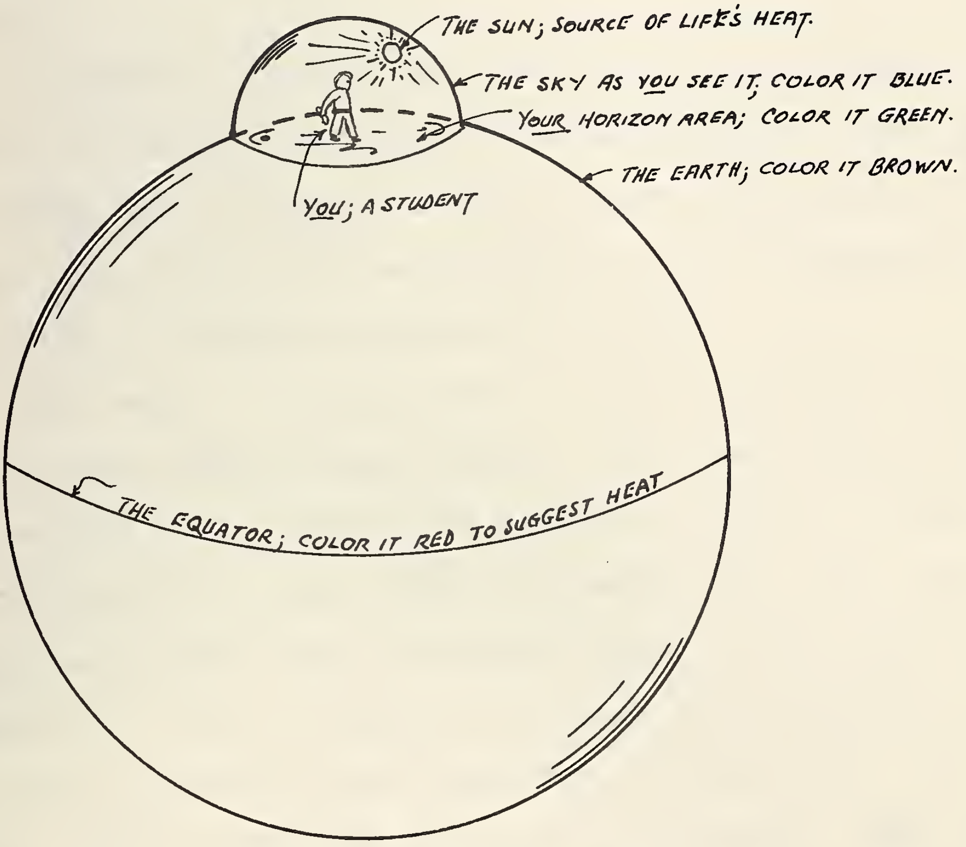
[illegible]

[illegible]

[illegible]

to <u>all</u> the other things about. So too with our study of heat. You will see different parts of the study in relation to the whole picture. This is what I should like to have you think about as you proceed with your work.

Now for another 'mind's-eye picture', which I am sure you will enjoy thinking about, because it fits <u>you personally</u> into the WHOLE of your surroundings.



A VERY LARGE "WHOLE-IDEA".

You will notice that you, your horizon, and the sky you see, form a part of the whole earth on which you stand. You might say that this is a bigger WHOLE than the OVERVIEW "IDEA-sketch" on page 111, and that may be true. Our heat study is really a "sub-whole" or smaller whole than the picture above.

Note that the sun is the source of heat which warms up your horizon area; it also heats up horizon areas of other boys and girls all over the earth whenever the earth turns toward the sun. They all have different horizons and sky-pictures from yours, don't they. That is really easy to understand.

The scientist likes to ask questions. He is always faced with a big question mark (?) which constantly asks WHY, WHAT and HOW. He is forever trying to solve the puzzles of our earth and of the universe; puzzles of life, puzzles of space, puzzles of matter, puzzles of energy.

In your study of science you too are a scientist because you think always about things, about everything, about what is around you. Now heat is everywhere about; the sun supplies us with heat, our homes are warmed with heat, and foods are cooked with heat; germs are killed with heat, and our bodies live only as long as they have heat in them.

It seems natural to ask ourselves what heat is. The textbooks tell us that heat is a kind of "energy". The word energy may trouble you a little but not if you stop to think of an energetic person. Such a person is able to do a lot of work.

The scientist says that "energy is ability to do work" and since heat does work for us we say that heat is a form or kind of energy. That really is very sensible, isn't it. The sun gives its heat-energy to our earth and to the other planets of the solar system. Someday it will use itself up and will have no more heat to give us, but that will take millions of years.

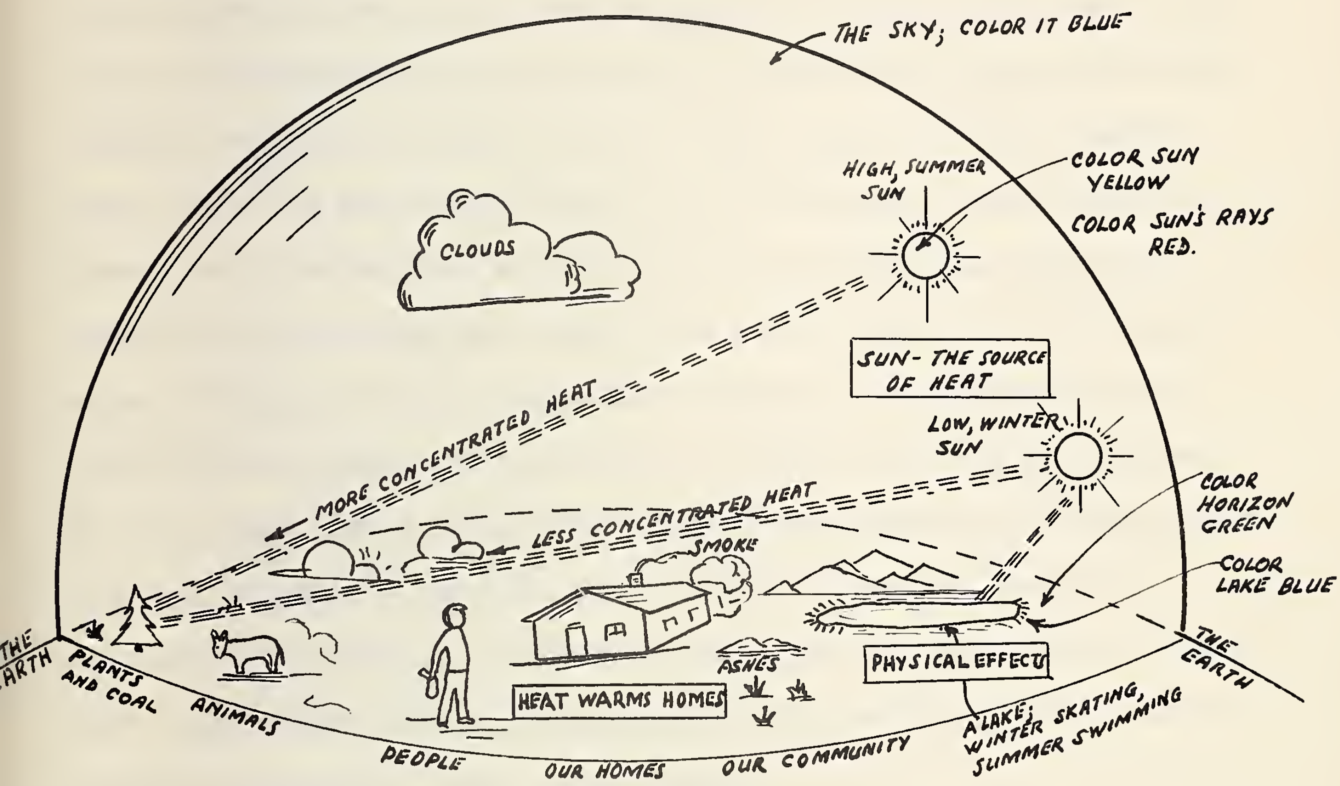
HEAT THEORIES:

Different theories or suggestions have been proposed to give us an idea of what heat is. At first it was thought to be something which slipped quietly into the heated body but since it did not increase in weight this theory was dropped. Another theory suggests that there are tiny particles in the body which go to make it up, and these get jostled about and begin to move very rapidly when the body gets hot. This idea is really easier to understand especially if we imagine a crowded theatre in which a fire breaks out. The people get into a panic and in their attempt to escape they are jostled about and I am sure that this jostling would make them really quite warm, especially if the doors were locked. So also in a heated body, the tiny particles of matter move about excitedly as if in a panic. If we heat the body strongly enough some of the particles escape as in heating water or candle wax.

SOURCES OF HEAT:

Below is a smaller "sub-whole" picture of our heat study. I think you will like it best, so far, because there are really fewer ideas to keep in your mind; and remember this: that

after your study is over you will only remember the main ideas and not all the material I am writing to you.



OUR ENVIRONMENT

The picture sketch indicates at a glance the value of heat in our lives. You will notice that there are three main parts to the sketch, which parts are shown in the small rectangles. These are the three main parts of our Heat Study. Let us list them.

TOPICS IN OUR HEAT STUDY

(A) Sources of heat.

(B) Physical effects of heat.

(C) Use of heat in warming our homes.

Now look again at the picture on page 114 and see if these three ideas stand out in your "locality-picture". You will note the sun as one source of heat which is of value to plants, animals, to you, to our home life. You will note also that the sun has an effect on the earth, especially on lakes and rivers; for we are able to swim in the lake in summer and skate on the lake in winter. We shall note many other effects of heat on solids, liquids and gases. The third idea is also in the sketch, namely, the value of heat in our homes and in all buildings where people live or work. Are you beginning to like thes "WHOLE" diagram ideas? I wonder if you find it easier to picture your science this way. May I say again, that I should like you to keep this picture in mind throughout your "Heat Study".

SOME THOUGHT PROBLEMS:

1. What are some types of fuel people use? Which ones have you in your home? Where did these fuels come from? How "in the world" were they made? Try to find a book which tells about the story of coal.

2. Did you ever hear of coke? Would you like to make some?

3. How does heat travel?

4. What systems of heating does man use in his buildings?

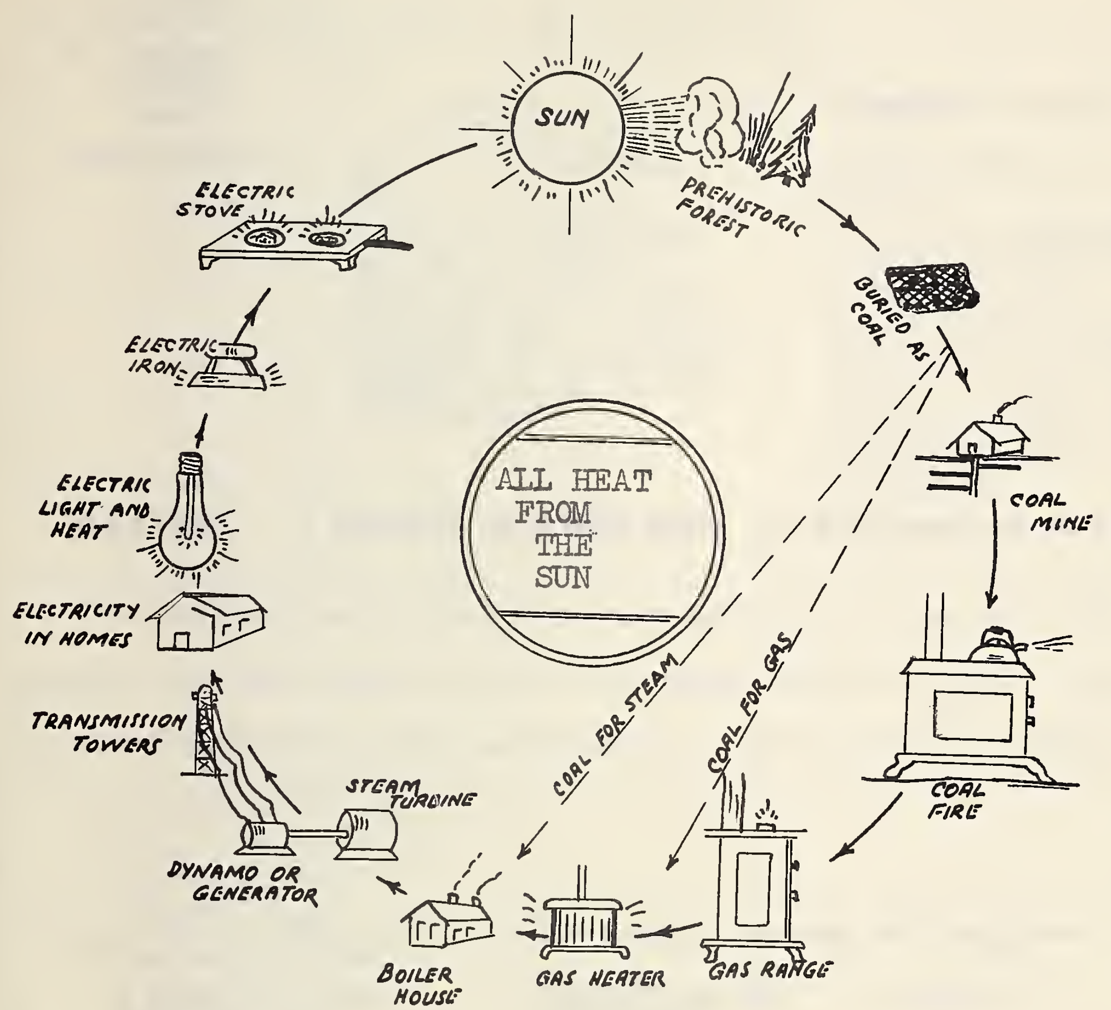
NOW LET US PROCEED WITH A STUDY OF SIX SOURCES OF HEAT.

(1) The Sun as the Source of all Heat.

We say that the sun gives off radiant energy, because like a car radiator it sends out heat in all directions. The sun is the source of life because without heat life must die. Can you close your eyes and picture the three ideas which were shown in the last diagram, and can you see the value of the sun's heat in our lives from day to day? Do you think the sun really does work for us? Does the sun make a locomotive go? Not directly, but if you read the story of coal you will see that the coal at one time grew above ground by means of sunlight and sun-heat. Our sketch shows us that today the sun does work for me, for the people in my home, for my community, for the world.

I am going to show you another diagram that indicates that "ALL HEAT COMES FROM THE SUN". I think you will like this "sub-whole" picture. It shows at a glance that electric heat, gas heat, heat from coal and heat from wood can all be traced back to prehistoric forests which required sunlight to make them grow. Today man uses this bottled sunshine to do his work. It is easy to understand the short cuts in the diagram running from the buried coal to the gas heater and boiler-house. The gas heater and gas range shown in this diagram use gas made from coal. Of course you know that natural gas is used in heaters and ranges but this gas comes from the ground.

ALL HEAT COMES FROM THE SUN

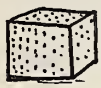


Study the diagram carefully and copy in your notebook.

Now do experiment number six in the "Experiment Manual" which accompanies this unit.

(2) <u>Heat from chemical action.</u>

The words 'chemical action' may bother you a little so I shall try to make them clear.

1.	2.	3.
		
SUGAR CUBE	SUGAR CUBE GROUND UP. THIS IS A <u>PHYSICAL</u> ACTION BECAUSE ONLY THE APPEARANCE OR FORM HAS CHANGED. NOTHING NEW HAS BEEN FORMED AND WE STILL HAVE SUGAR.	SUGAR BURNED IN A SPOON. THIS IS A <u>CHEMICAL</u> ACTION BECAUSE THE APPEARANCE HAS CHANGED AND SOMETHING NEW HAS BEEN FORMED. WE NO LONGER HAVE SUGAR BUT SOMETHING ELSE, QUITE DIFFERENT.
MATTER	**MATTER IN A NEW FORM**	**A NEW KIND OF MATTER**

Sometimes heat comes from the materials when they are burned, and the heat is often accompanied with light. When we burn fuels both heat and light are given off as a rule.

	COAL + OXYGEN	$\longrightarrow$ HEAT AND LIGHT
A PILE OF COAL WOOD OR OIL	COMBUSTION OR OXIDATION	PRODUCTS

The above diagram indicates the action in your kitchen stove. How considerate of nature that heat should be given us from the burning of coal and wood. You are now aware that chemical action is a source of heat which does work for us in such machines as steam tractors, locomotive, and gasolene engines

In your notebook tell about the burning of oil and of gasolene in tractors and cars. Show how the heat which results does work for your community.

Can you write a short paragraph in your notebook telling me of the value of chemical action as a heat producer for you, your home, your community and for distant communities?

Now do experiment number one in the "Experiment Manual A" which tells how to make coal gas. This is an example of chemical action. Why?

Now read your text on the subject "Heat from Chemical Action".

(3) Heat from friction.

A third source of heat which is quite common to us is that obtained from friction or rubbing of two surfaces together. When our hands are cold we rub them. When we bore into wood with a drill the drill gets hot from the friction of wood and steel. The early peoples made fire by rubbing sticks together and boy scouts use the very same method today. We should never clean silk with gasolene inside a house because the friction may cause a spark which will ignite the gasolene vapour and set the house afire. Many people have been badly burned in this way; we should clean clothes with some non-inflammable material, and preferably out of door. Ask your father to tell you what a 'hot-box' is on railway cars.

Perform experiment number two in "Experiment Manual A". Then in your notebook write a short report on the value of heat from friction to you, in your home (matches) and in your community (no need to borrow fire as was done in early days).

Now read your text and see if there is any information we have not dealt with.

(4) Heat from compression.

Perform experiment number three in "Experiment Manual A". This shows that heat results from compressing any gas, or from compressing air. Our Chinooks in southern Alberta melt winter snows and dry up lakes in summer. This is due to the descent of air from the mountains slopes, the heavy air at lower altitudes compressing the air as it comes down and raising its temperature.

Does your text tell anything about heat from compression?

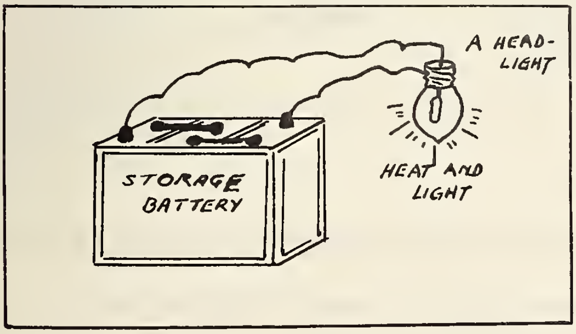
(5) Heat from percussion.

Lead shot if directed at a metal target will melt because of the heat generated by the percussion. Shot gun shells and cartridges are set off by a cap which ignites and sets the powder off. Submarine warfare also makes use of this principle in its use of torpedoes.

Do experiment number five in "Manual A", being careful not to hold your face close. There is no danger so long as you do not take too much of the materials referred to.

Read your text on this topic, if there is any information on it.

(6) Heat from electrical energy.



The diagram to the left shows how an automobile lamp is lighted by a battery. The light gives off heat; so too do electric toasters and irons. Write a short account in your

notebook on the value to modern life of heat from electrical action. What is the value to your community if any, and to distant communities?

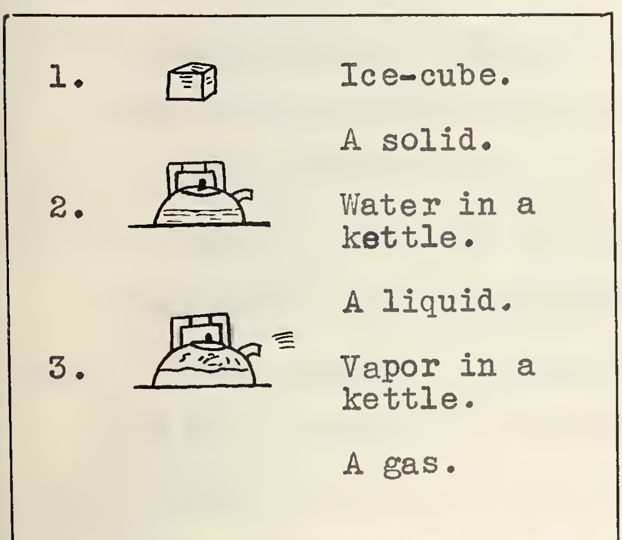
Perform experiment number four "Experiment Manual A", and then read your text book for further information.

....

SECTION (B). PHYSICAL EFFECTS OF HEAT ON MATTER.

Matter is anything that occupies or takes up space. We live in a world of matter for everything about us is material. Matter is all of the "material" things in the universe.

Physical changes in matter are changes in form, shape, color and the like. Matter exists in three distinct forms or states:



(1) gas, which is usually invisible although chlorine gas used in warfare is green. Water vapor is a gas.

(2) liquid, which unlike gas is visible and takes the shape of the container; rain is a good example.

(3) solid; this form has a definite shape.

Let us pause and think back to our "WHOLE-DIAGRAM" on page and try to recall these three forms in relation to our environment.

Now let us continue.

(1) <u>Physical effects from heating gases:</u>

Perform experiments eight, nine, and ten in "Experiment Manual A". You will learn that heat makes air stretch or expand and when cooled it shrinks or contracts. Perform experiment eleven also.

Read your text on this topic.

(2) <u>Physical effects from heating liquids</u>.

Get a cheap thermometer and breathe on it; then put some snow on the bulb part and record what happens. You will note that the liquid in the thermometer stretches or expands when heated and shrinks or contracts when cooled.

Now perform experiments seven and fifteen in "Experiment Manual A".

(3) <u>Physical effects from heating solids:</u>

Even iron stretches when heated and shrinks when cooled. Have you ever seen the small space between the steel rails or tracks? What do you think this space is left for?

Pianos and violins when left in cold rooms are often found to have snapped strings. Why?

Ask your dad how the blacksmith puts the steel rim on buggy or wagon wheels in order to get a tight fit.

Perform experiments twelve, thirteen, and fourteen in "Manual A" and then read your text on this topic.

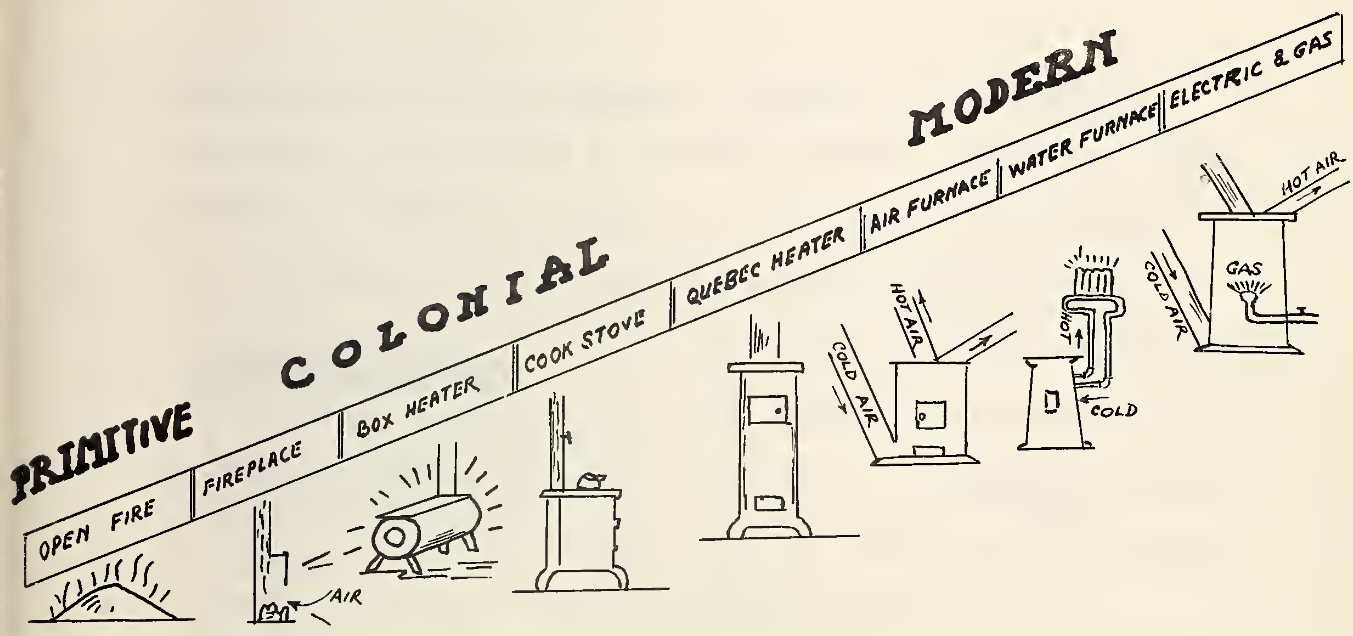
Write a short account in your notebook of the beneficial value of heating solids: to you, to your home, and your community. Find out about the construction of the balance

wheel of a watch and write a report about it.

Perform experiment sixteen in "Manual A".

We are now to complete the third part of our "WHOLE-DIAGRAM" study on page 114. Can you recall it without looking back?

SECTION (C): USE OF HEAT IN WARMING THE HOME.



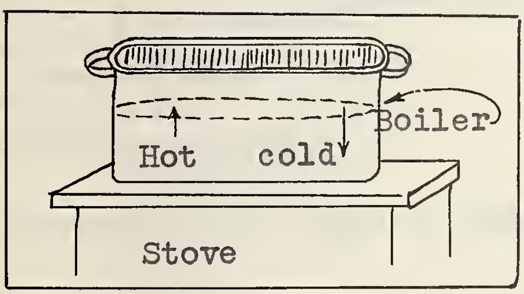
THE EVOLUTION OR DEVELOPMENT OF HEATING

(a) Getting heat from one place to another by CONDUCTION. Just as an orchestra conductor leads his players along in their playing, so too heat applied to the end of a poker is led along to the other end. The heat is passed on from particle to particle by successive impacts. Perform the interesting experiments, numbered 17, 18, 19, and 20, in "Manual A".

Now read your text on the topic of "Heat Conduction".

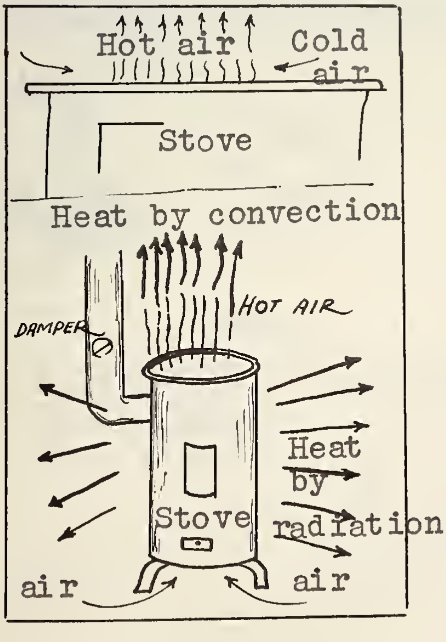
(b) <u>Getting heat from one place to another by CONVECTION.</u>

Convection comes from the word 'convey', to carry along. I may convey a bucket of water from the well to the house. When heat is conveyed, the matter actually moves along.



A boiler of water on the stove is heated by convection. The hot water is <u>conveyed</u> upward (it is light) and it carries its heat with it.

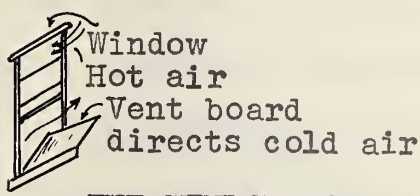
Another example with which you are quite familiar is the heating of air over a stove. The air moves upwards and carries its heat along with it. Thus air and water are heated in the same way, viz. by convection. Paper hangers and plasterers find it very hot near the ceiling. Have you noticed how



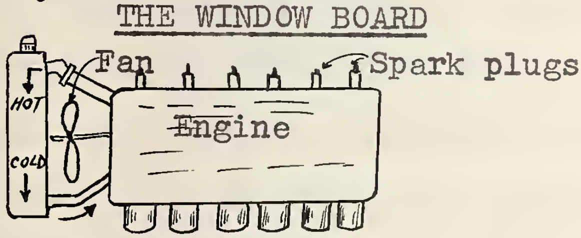
much hotter the upstairs of your home, or the loft of a barn is in the summer time than when you are down below? The upper rooms have been heated by convection. Why do you think the barn is equipped with a cupola?

Write a short composition in your notebook on 'The Value of Convection', making reference to yourself, your home and the community.

Perform experiments No. 21, and 22 in "Manual A".



THE WINDOW BOARD



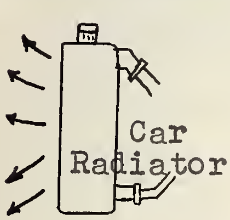
CONVECTION IN A CAR RADIATOR

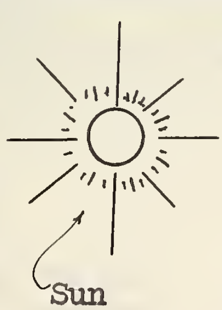
Interpret the two diagrams entitled:

The Window Board, and Convection in an Automobile Radiator.

Now read you text on the topic of convection.

(c) Getting heat from one place to another by RADIATION.





Foot warmer

A car radiator 'radiates' or throws off heat in all directions. The sun also radiates heat in all directions. House radiators or foot-warmers (or car-heaters) send out heat in all directions by the process of radiation. Do experiment

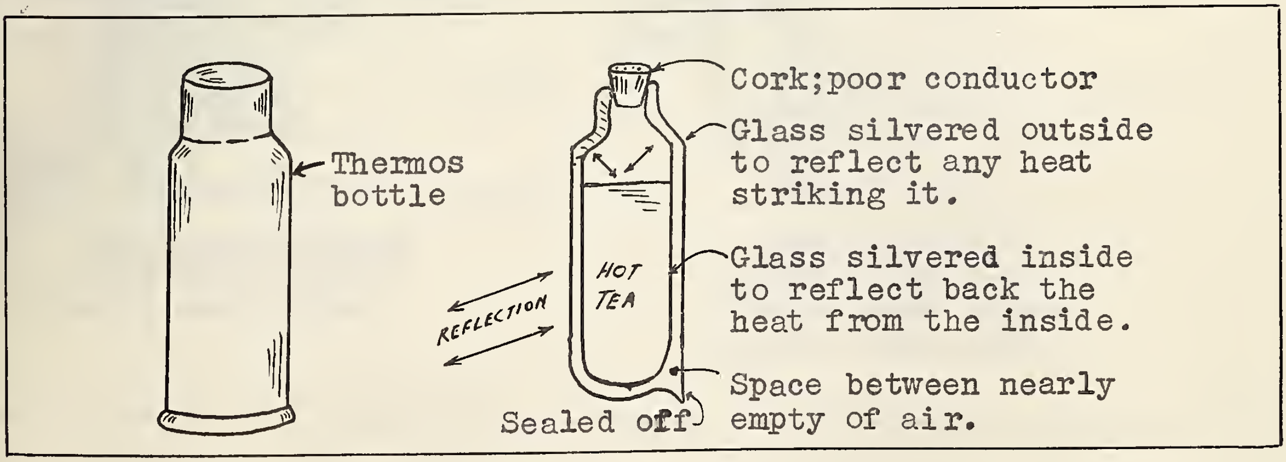
No. 23 in "Manual A" and then read your text on the topic of radiation.

We are now about to complete our studies and this will finish our study on Heat. Do you still have a mental picture of the "WHOLE-DIAGRAM", on page 114 ? Let us go on.

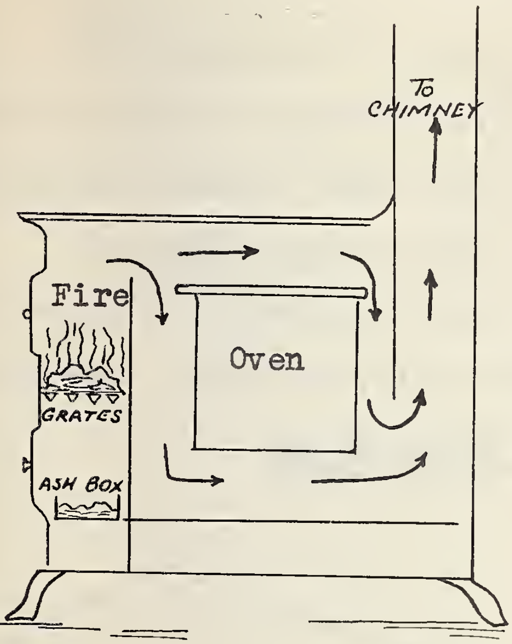
CONSERVING HEAT IN OUR HOMES.

You may read your text to find out how our homes are heated by stoves, fire-places, hot-water furnaces, air furnaces and steam furnaces. We are much concerned with the ways in which heat is prevented from escaping from our homes.

The principle: Have you ever seen a thermos bottle? Try to obtain one and take it apart. The thermos bottle really consists of two bottles with a space between. The air is nearly all taken out of this space in order to keep heat from travelling across it. In this way, because heat will not travel through a vacuum, or through a rarefied space, the thermos or vacuum bottle keeps things hot or cold. The bottle is silvered inside and out; in this way the heat that strikes the inside is reflected back again; the heat that strikes the outside is reflected away so as not to reach the inside.

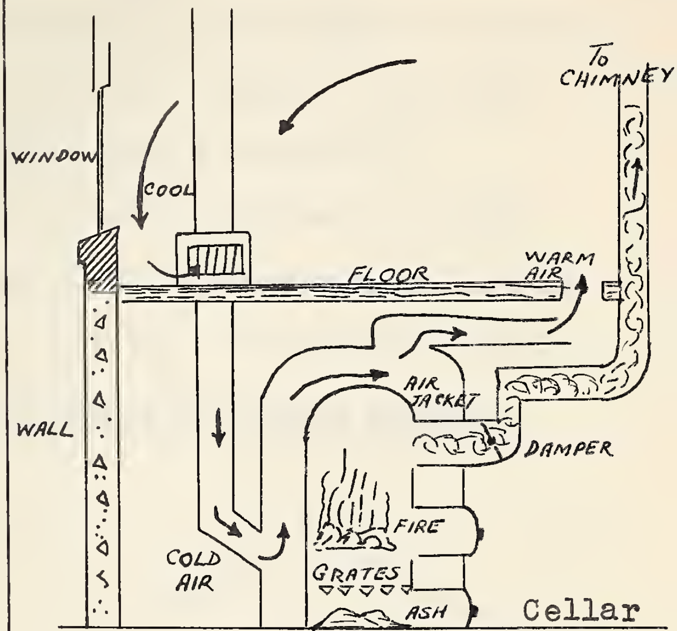


METHODS OF HEATING OUR HOMES

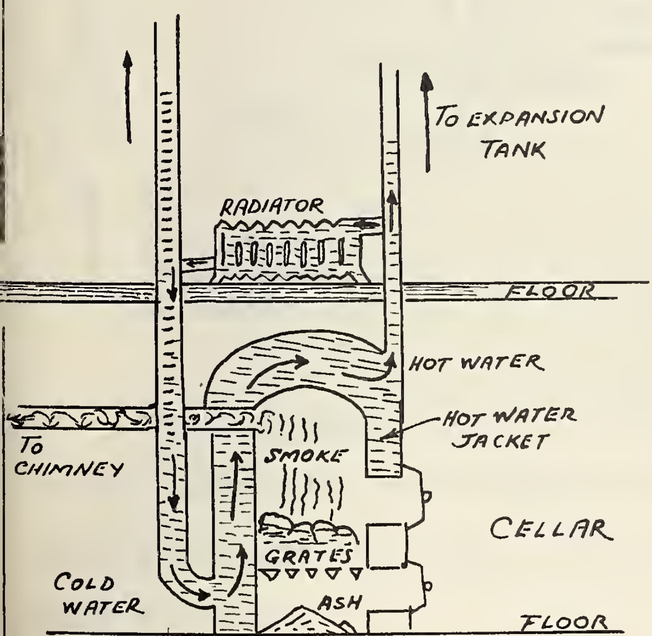


A COOK STOVE

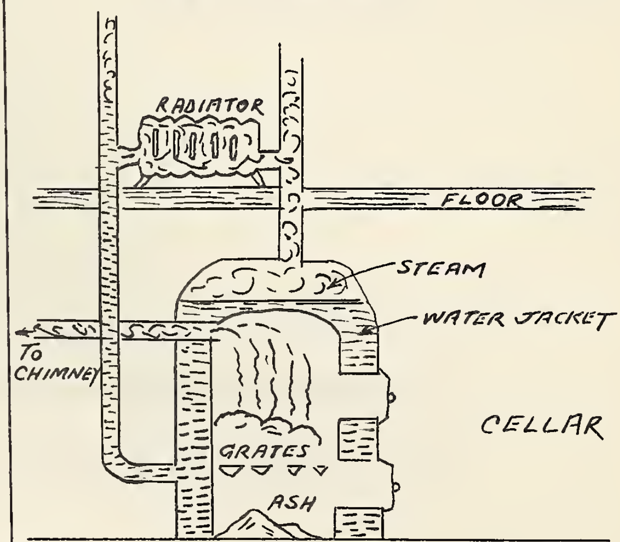
(color air path red)



HOT AIR HEATING
(color air channel red)
(color smoke path gray)



HOT WATER SYSTEM
(color water red)
(color smoke gray)

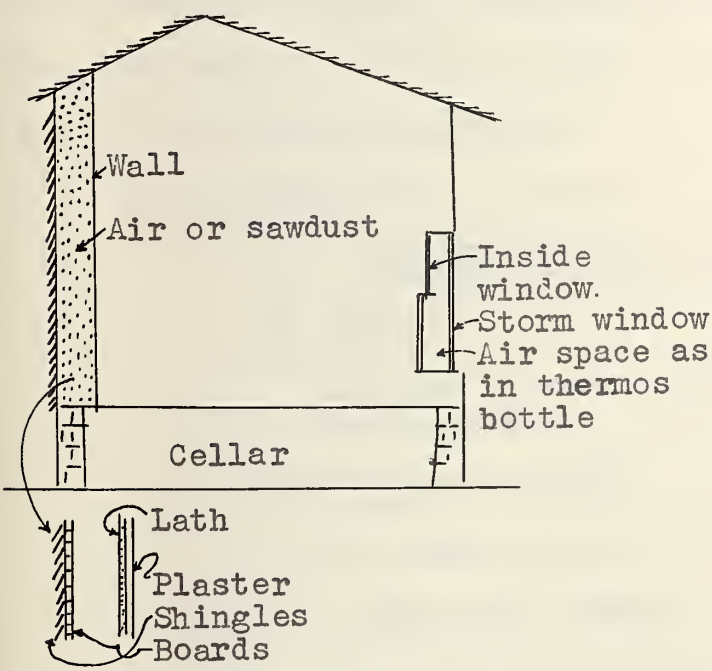


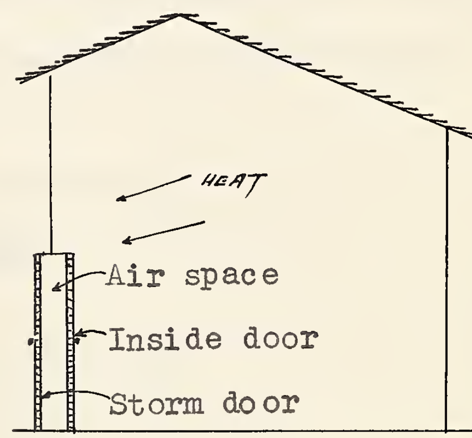
STEAM HEATING
(color steam red)
(color water blue)
(color smoke gray)

Do experiment No. 24 in "Manual A". It suggests that you try to make a fireless cooker. The wool lining is airy and does not conduct heat away from the cooked materials.

On this page you will find a sketch diagram of houses showing the effects of hollow walls, of storm doors and storm windows. Have your dad tell you how they build house walls.

HOMES: Walls, storm doors and storm windows





Write a short report in your notebook on "Heating our Homes" after you have examined the sketches on page 127 . Note carefully the arrows which indicate the path of the heat currents.

Now read your text on the subject of heating our homes.

Now let us look at a re-view or "WHOLE-PICTURE" of our study in a little different way. The diagram appears on page 130 and aims to find out if you have 'caught on' to the whole study of heat in such a way that you can see it all at once and could answer any questions on the work we have done together. Just think of this diagram when you answer the test questions at the end of the study. Send me the answers to your test, and tell me how you liked the method of studying this subject of HEAT. I hope you will find the test a bit of fun, for really learning is fun if we look at it in the right way; it is very satisfying too.

Let us summarize our study in a tabular way:

SUMMARY REVIEW OF HEAT.

A: FUELS:

Burning of wood, coal, gas, oil.
Heat sources.

B: EFFECTS OF HEAT.

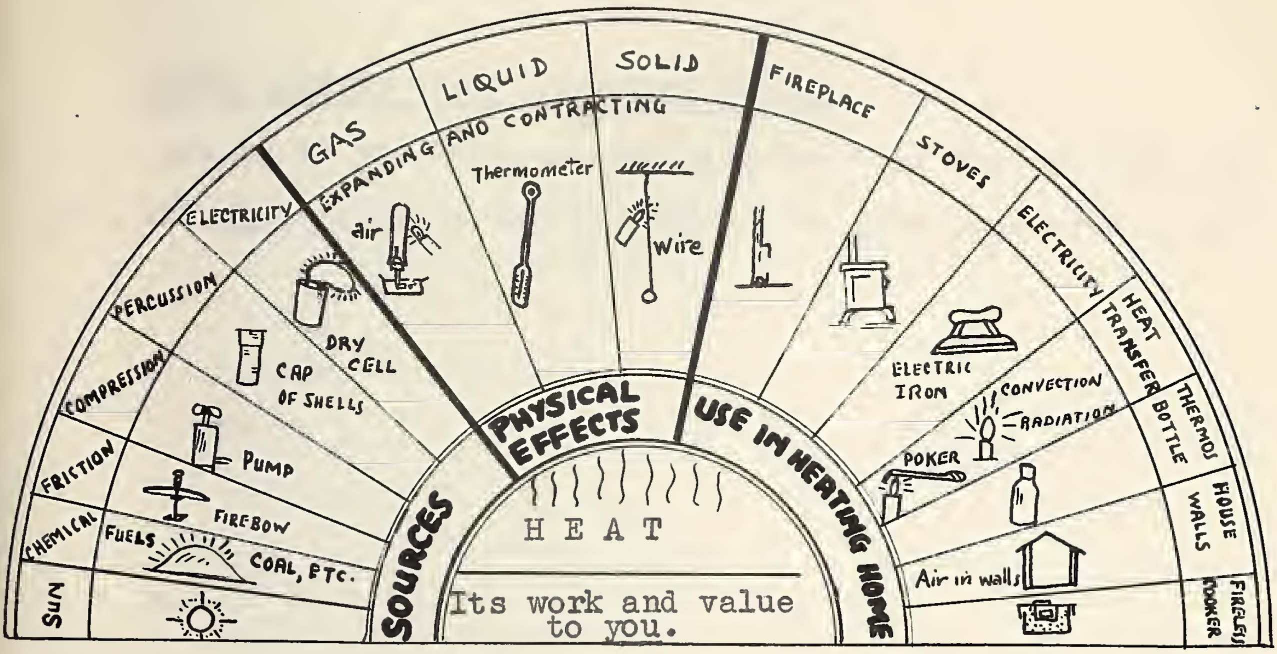
On gases, liquids, and solids.

C: WARMING OUR HOMES:

Ways of distributing heat.
Heating system.
Conserving heat.

Let us proceed directly to the examination of a review picture of our heat study. It would be well to study it carefully and then to copy it in your notebook .

THE RE-VIEW DIAGRAM
(A whole-picture study)



Can you see this mind-picture in your 'mind's eye' ?

Here are some general ideas you should have gathered about your study of heat.

1. HEAT IS OF VALUE TO US. (cooking, warmth, etc.)

2. WE CAN MEASURE HEAT WITH A THERMOMETER.

3. HEAT IS MOVEMENT AND CAUSES MOVEMENT.

4. HEAT IS CARRIED FROM PLACE TO PLACE BY CONDUCTION.

5. WATER, WOOL, AIR, PAPER, FLANNEL , ARE POOR HEAT CONDUCTORS.

6. HEAT COSTS MONEY SO WE TRY TO CONSERVE IT.

Can you list five or six additional general statements about what you have learned on "Heat, and the Work it Does for Us" Please send me your general ideas or statements.

Now read your text through on the subject of "HEAT". Tell me of anything you don't understand and wish help on.

PLEASE ANSWER THESE QUESTIONS FOR ME

1. Tell me if you have enjoyed studying this Unit on Heat or not, and why. I shall be very pleased to have your true opinion.

2. Is it different from the ordinary way that texts use? How? Do tell me just how you feel about the study.

YOUR FINAL REPORT TO ME ON YOUR HEAT STUDY.
(Tear out these test pages and send them to me)

(Send this to me and I shall return it to you corrected and then you may file it away in your records. You should try to answer the questions without reference to your text or your note-material I have sent you.)

1. Fill in this tabulation:

SOURCE OF HEAT	IN NATURE	IN A COUNTRY OR CITY HOME Omit
1. Compression	....	....
2. Electrical	....	....
3. Chemical action	....	....

2. Describe an experiment to illustrate heat production by Friction.

3. Write out an experiment to show that iron expands when heated.

4. Fill out the following table.

OBSERVATION	SCIENTIFIC PRINCIPLE INVOLVED.
(example) Smoke rises in chimneys.	Convection due to heat.
(a) A poker handle gets hot.	....
(b) Winds blow.	....
(c) The sun warms the earth.	....
(d) Preparing boiling water for tea.	....
(e) Putting our hand on a hot car-fender in mid-summer.	....
(f) Getting warm near a bonfire.	....
(g) Covering plants on a frosty night.	....
(h) Packing ice in sawdust in summer.	....
(i) Putting on storm windows.	....
(j) A soldering iron has a wooden handle.	....
(k) Furnace grates are set loosely in their frames.	....
(l) The vacuum bottle.	....

5. Draw a diagram of the method used in hot-air heating in Alberta homes. Use arrows to show air movements. Color the smoke path in gray (lead pencil) and the air paths in red.

6. After a snow fall, your neighbour's roof was covered with snow, while the roof next door was clear. In which house would you rather live in a cold spell, and why?

7. Why does a wool scarf feel warmer on the neck than a silk one?

8. Why will a hot-air heating system heat a house more quickly than a hot-water heating system?

9. Explain fully with the aid of a diagram why a room is usually warmest at the ceiling.

10. Name 10 important ideas of a general nature which you have gained as a result of your study of Heat.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

7. ______________________________

8. ______________________________

9. ______________________________

10. ______________________________

11. Write a short paragraph on what you have learned of the method of "wholes" and tell what you think of the method.

Note:

In writing an account of an experiment always use these heading in the margin.

1. TITLE: Heat
2. PURPOSE: To prove......etc.
3. MATERIALS: List apparatus used.
4. METHOD: Start with a diagram sketch.
   Tell briefly what was done.
5. OBSERVATION: What did you observe?
6. CONCLUSION: Is the purpose achieved? Tell why.
7. APPLICATION: What is the practical application in our lives?

....

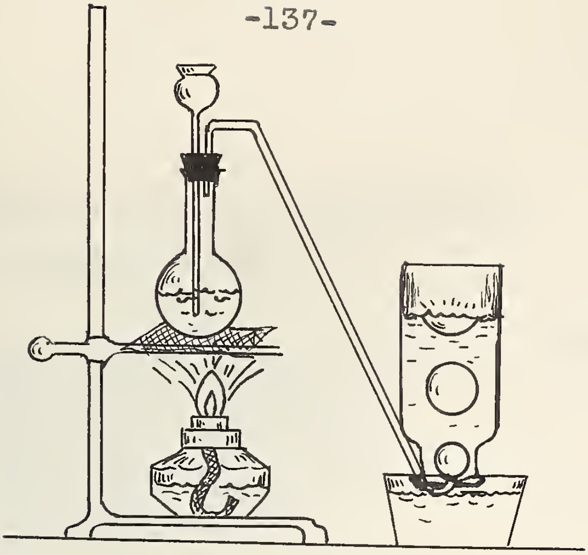
APPENDIX 4

MANUAL A

Guidance of laboratory work

on the

<u>HEAT</u> unit



AN EXPERIMENT MANUAL.

On

THE "HEAT" UNIT.

Things to do during your study of Heat.

(some real fun)

A - SOURCES OF HEAT.

B - PHYSICAL EFFECTS OF HEAT.

C - USE OF HEAT IN WARMING HOMES.

@@@@@@@@@@@

Practical applications at the end of the manual.

Name:--------------

APPENDIX 4. MANUAL A.

Guidance of Laboratory Work on the HEAT unit.

CONTENT OF THIS EXPERIMENT MANUAL.

Section A: Sources of Heat

Section B: Physical Effects of Heat.

Section C: Use of heat in homes

....

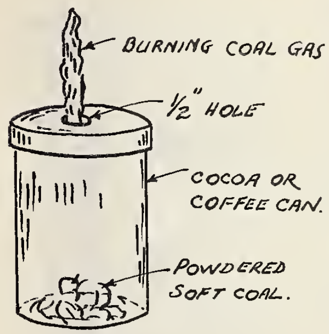
YOUR EXPERIMENT KIT

HEAT STUDY

Alcohol lamp
Alcohol
Bags, paper (2)
Balloon (1)
Beaker (1)
Burning glass (1)
Bottles, medicine (2)
Can, cocoa (1)
Candle (2)
Cell, dry (used)(1)
Coin (Penny) (1)
Chemicals
Potassium chlorate (4 oz.)
Sulphur, powdered (4 oz.)
Coal
Corks, 1 hole
Corks, 2 hole
Corks, plain
Curtain rod (old)
Eye hooks (2)
Fire-bow (home made)
Florence flask (1)
Gauze, wire, 4" x 4"
Hammer (1)
Lumber, old boxes
Needle, darning (1)
Pin-wheel (home made)
Pump (bicycle)
Rod, iron, 15" x 1" x $\frac{1}{4}$"
(Strap iron)
Rod, round, 15" x $\frac{1}{4}$" diam.
Sawdust, ($\frac{1}{2}$ cup)
Stoppers, rubber, 1 hole,
2 hole, plain.
Support stand (home made)
Test tubes (2)
Test tube clamps (home made)
Test tube rack (home made)
Thermometer (Woolworth's)
Tubing, glass (one 12" length)
Tubing, rubber(one 12" length)
Wire (2 one-foot pieces)

SECTION A

EXPERIMENT No. 1: To obtain heat from chemical action.

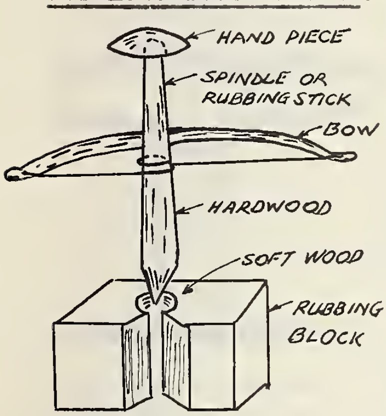


Punch a ½" hole in the top of a cocoa can. (use closed scissors). Insert about five table-spoonsful of coal in the can and cover it up. Put it over the fire on a stove. Light the gas after a while. When the gas has burned let the can cool.

Open the can and smell the black liquid; it is coal tar and gives us many beautiful dyes.

Note the coke left in the can too.

EXPERIMENT No. 2. To obtain heat by rubbing. (friction).

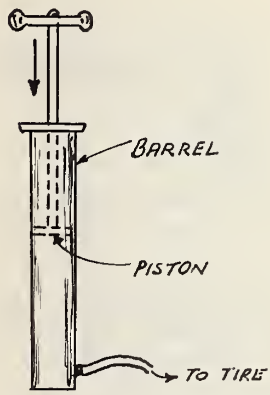


This is a primitive way of making fire. It is used by Boy Scouts today. Try it out. Use heavy string or leather for the bow-string.

Another very common way of getting heat from friction is the ordinary match. Perhaps your dad can show you that a drill gets hot when he uses it in hard wood.

SECTION A

EXPERIMENT No. 3. To show that compression produces heat.

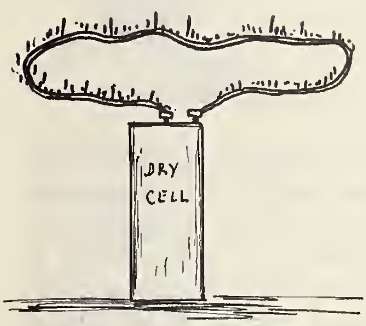


When using a bicycle pump to inflate a tire, or even a car pump, take hold of the barrel or cylinder and note how warm it is at the bottom. Is it as warm at the top?

The heat is due to the compressing of the particles of air in the barrel and in the tire.

This principle explains the cause of our Chinooks. As the air descends from the mountains the heavier air in the foothills squeezes or compresses the air and it gets warm. For this reason our southern lakes are dried up in summer and in winter the snow melts.

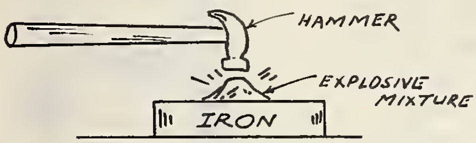
EXPERIMENT No. 4. To show that we can get heat from electrical energy.



Procure one or two partly used dry cells and connect a piece of fine insulated wire about a foot long to the two terminals. The cotton covering will start to burn; as soon as it does so disconnect the wire to save the dry cell. If you have no cotton-covered wire use a piece of any fine wire and as soon as it is connected try to touch it.

SECTION A

EXPERIMENT No. 5. To show how to obtain heat from percussion.



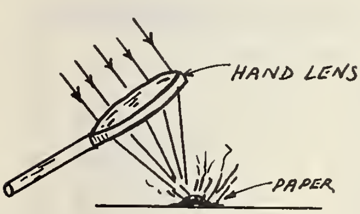
BE CAREFUL; TAKE ONLY ENOUGH OF MIXTURE TO COVER A DIME. STAND OFF.

Mix a bit of potassium chlorate and sulphur by hand and hit a bit of the mixture with a hammer. The burning is so rapid that a loud explosion results.

Gunpowder is merely potassium chlorate mixed with sulphur and soot.

The cap that sets off cartidges and gun shells is often called a percussion cap. You can understand why now.

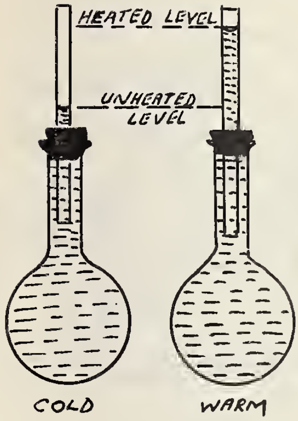
EXPERIMENT No. 6. Heat from the sun.



It is not really necessary to prove that the sun gives off heat. However it is interesting to take a burning glass, (the lens of a flashlight often works well) and concentrate the sun's rays on a piece of cloth or newspaper. The sun's rays that strike the glass are not strong enough to start a fire but if they are collected at one point they are more powerful. Primitive man would have been fortunate to have had a burning glass.

SECTION B

EXPERIMENT No. 7. How to make a thermometer. (Liquid type)



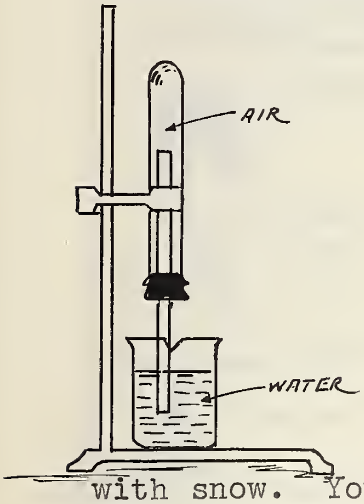
Take a florence flask or test tube (a florence flask is shown) and fill it brimful of water.

Insert a piece of glass tubing through a one-holed cork as shown and fit into the flask or test-tube.

Some of the water rises a little way.

Now heat the flask with care (see Manual of Instructions) and note the rise. Do not let the water run over. Now put the bulb of the flask in luke-warm water, and then into colder water and gradually into snow. This is a water thermometer and was one of the first made.

EXPERIMENT No. 8. How to make an air thermometer.

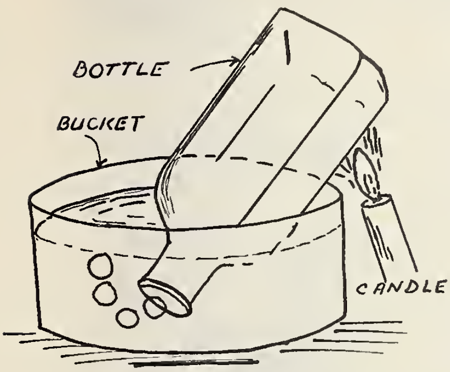


Fix up the apparatus as shown. The cork and glass tube are inserted into an empty test-tube (or florence flask). It should be held up by means of the support stand described in the Instruction Manual.

Heat the test-tube gently with a candle or alcohol lamp. Then cool gradually (care! not to crack the glass) finally finishing with snow. You may be able to get the water to come up into the test-tube. Try it and see. This too was a very early type of thermometer, but it would freeze in our Alberta winter.

SECTION B

EXPERIMENT No. 9. To show the effect of heat on air. (1st. method.)

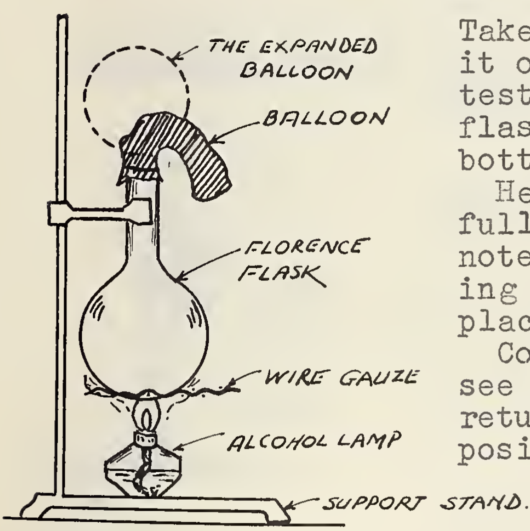


Find a bottle, preferable one with a long neck, (a medicine bottle will do) and put the opening in a bucket of water.

Heat the bottle carefully by letting the flame play about and not only in one spot.

This is the same process as in Experiment No. 8, and shows that air stretches when it is heated. We say that it expands.

EXPERIMENT No.10. To show the effect of heat on air. (2nd Method)



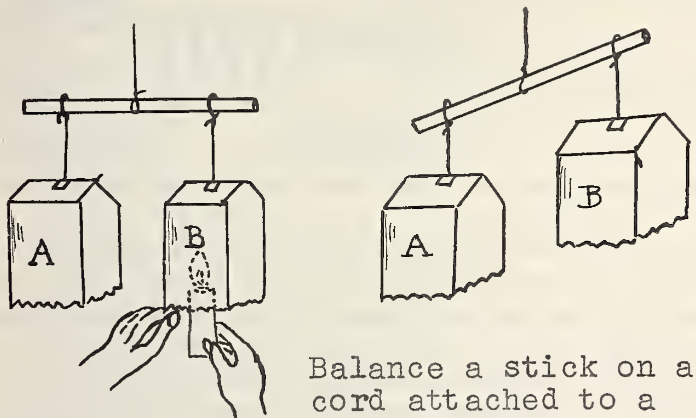
Take a balloon and fit it over the mouth of a test-tube or florence flask or even over a bottle.

Heat the vessel carefully and slowly and note what an interesting happening takes place.

Cool the glass and see if you can make it return to its original position.

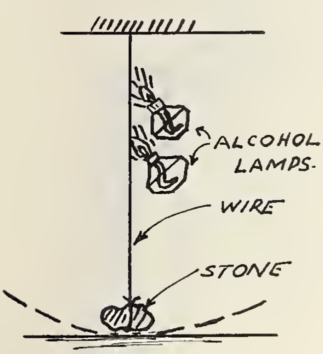
SECTION B

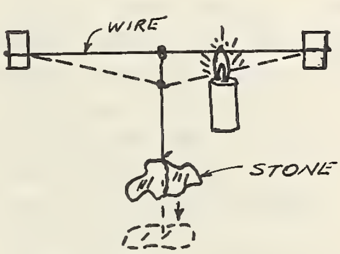
EXPERIMENT No. 11. To show that hot air is lighter than cold air if we take equal volumes.



Balance a stick on a cord attached to a support, and balance two similar paper bags upside down near its ends. Hold one bag and heat the air in it. Remove the candle and the bag rises when released. What do you conclude?

EXPERIMENT No. 12. To show the effect of heat on solids. (Wire experiments)

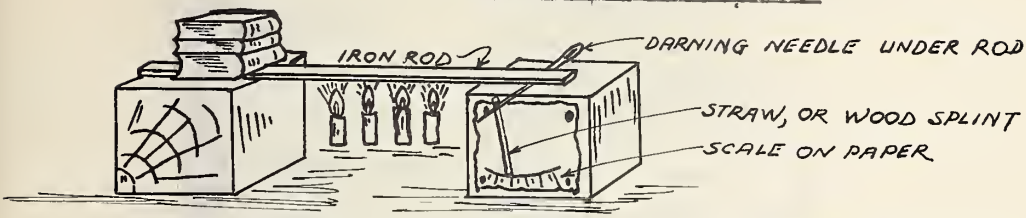




As in the left diagram tie a stone to a support and let the stone swing so that it just touches a table. Heat the wire and note results. As in the right diagram tie the wire between two chairs and fasten the stone in the centre. Heat the wire as shown.

SECTION B

EXPERIMENT N. 13. To show the expansion of solids due to heat.



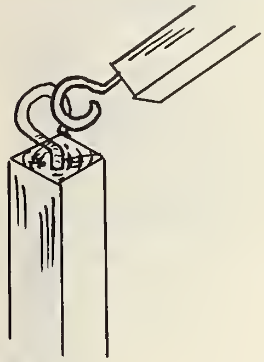
NOTE: BORE HOLE WITH STEEL DRILL IN BAR UNDER BOOKS AND NAIL TO BLOCK

Place a piece of strap-iron (your dad will get you a piece) about 15" x 1", between two blocks of wood as shown. Pile books or weights on one end; let the other end rest on a darning-needle, through the sharp end of which is fastened a wheat straw or broom straw, (or a fine wood splint).

On the right hand block a paper has been tacked, on which a scale has been drawn.

Now use several candles, or two alcohol lamps, and see what happens.

EXPERIMENT N. 14. To show the expansion due to heat in another way.

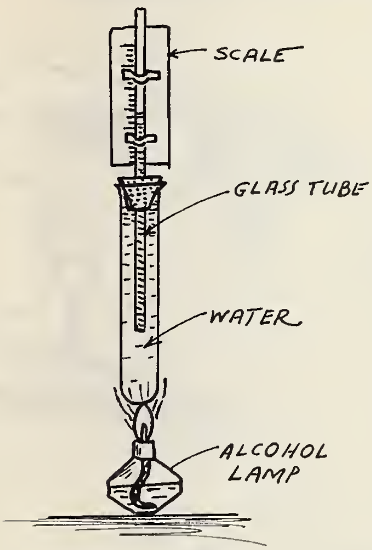


Take two small eye hooks and fasten them into two pieces of wood. Bend one eye with a pair of pliers so that it just fits the other eye, i.e. it just slips through.

Now heat this eye in a flame and see if it will go through the other eye.

SECTION B

EXPERIMENT N. 15. The effect of heat on liquids.

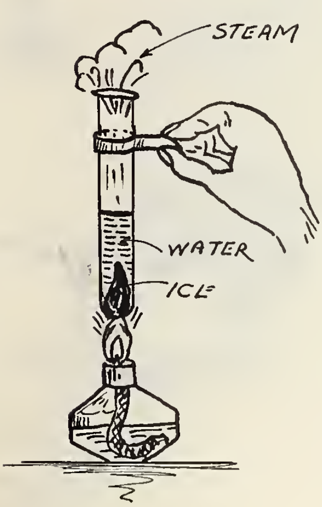


The test-tube is filled, brim-ful, before the cork and glass tube are inserted. Insert the cork and note what happens to the liquid.

To make it look like a thermometer place a piece of paper on which you mark a scale of your own choosing.

Now heat the tube and read the scale.

EXPERIMENT N. 16. To identify three forms or states of matter.



Place some ice and snow in a test tube and heat the tube.

Note that we started with solid material.

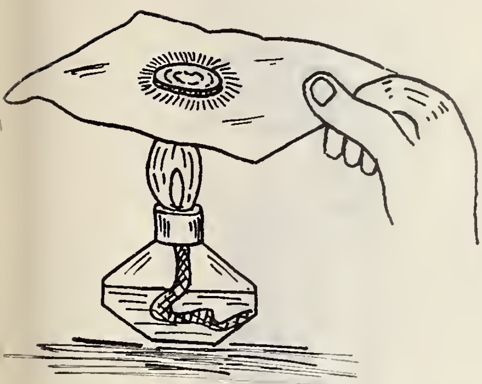
Heating changes the solid to liquid, a different form of matter.

Heating still further changes the liquid to a gas (steam) the third state of matter.

Can you identify these three forms in nature?

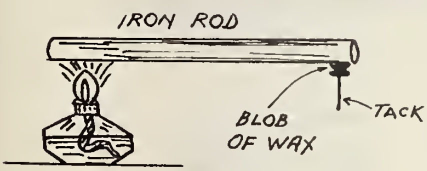
SECTION C

EXPERIMENT N. 17. To illustrate heat transference by CONDUCTION.

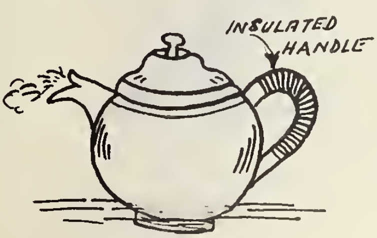


Put a 50¢ coin on a piece of paper and move it about over a flame so that it doesn't take fire (just let it scorch). The part where the coin was, is left unscorched because it carried or CONDUCTED the heat away from the paper.

EXPERIMENT N. 18. Further illustrations of heat transference by CONDUCTION.



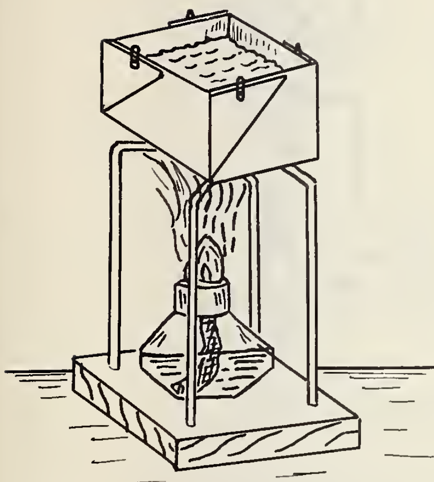
Fasten a tack with a drop of candle wax to the end of an iron rod and heat the other end with a candle. Note what happens.



The tea-pot shown has an INSULATED handle of bone, ivory, or cork covering, to block off or prevent heat conduction.

SECTION C

EXPERIMENT No.19. A very interesting 'conduction' stunt.



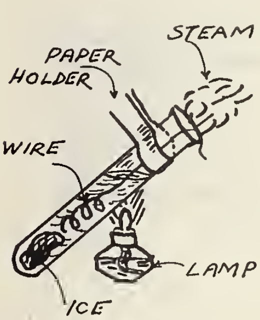
Make a paper box as shown, folding the ends carefully and fastening them with paper clips or with glue. Use good quality paper.

Place the box on a heating stand and without any wire gauze between, heat the box directly.

The water conducts the heat away and keeps the paper from burning.

It won't work without the water.

EXPERIMENT No.20. To show that water is a poor heat conductor.

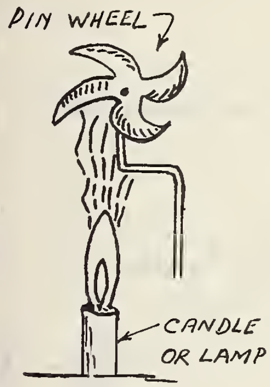


Fill the tube two-thirds full of water. With a coiled piece of wire hold down a piece of ice in the bottom of the tube.

Boil the water by heating near the top water surface. Keep the flame below the water line or the glass will crack. The ice does not melt showing that heat is not conducted to it through the water.

SECTION C

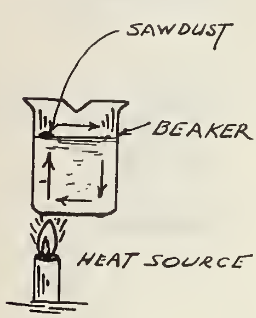
EXPERIMENT No. 21. To show CONVECTION IN AIR.



Make a pin-wheel as shown and fasten it to a wire. Hold the pin-wheel over a candle or hot stove and see if you can get the wheel to turn because of the rising current of air.

In heat convection the heated body (air) moves but this is not the case in heat conduction.

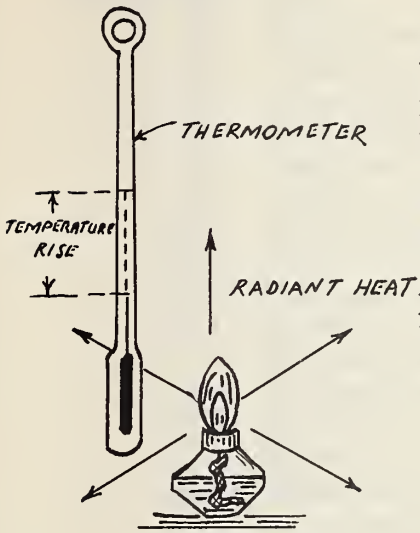
EXPERIMENT No.22. To show CONVECTION IN WATER.



Place a few specks of saw-dust on one side of a beaker of water and heat under the beaker and directly below the saw-dust. See if the saw-dust moves along the surface.

SECTION C

EXPERIMENT No. 23. To illustrate heat transference by RADIATION.

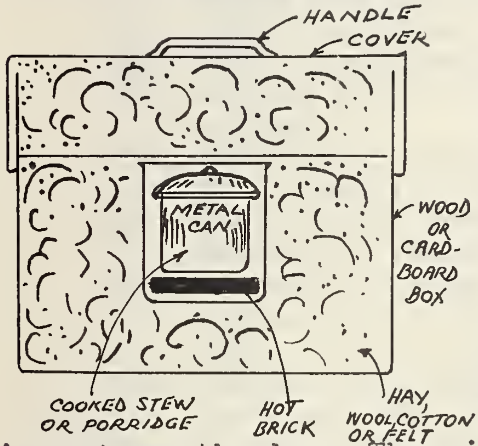


Hold a candle near the bulb of a thermometer and note the rise in temperature.

The heat spreads out in all directions from the candle.

This is how a fireplace or a kitchen stove throws off its heat.

EXPERIMENT No. 24. To show how to make a fireless cooker and to show that heat travels poorly through gases.



A wood or cardboard box is lined with felt, wool, cotton, hay or excelsior.

A metal can is placed in the centre.

Foods are partially cooked and put in the can. The cover, which is also lined, is put on the box. The air in the wool will not conduct the heat away and the food keeps on cooking. In some cases a hot brick is placed in the bottom of the metal box.

PRACTICAL APPLICATIONS.

Expt. No.

1. Making coal gas in Vancouver.
2. Oil in engines and wheel hubs.
3. Chinooks in Alberta.
4. Electric toasters and irons.
5. Torpedoes, shells, explosives.
6. Sun engines (not much in use)
7. Mercury and alcohol thermometers.
8. Air thermometer;historical interest.
9. Tires bursting in summer driving.
10. Hot air balloons.
11. Heating and ventilating; furnaces in the basement.
12. Thermostats (read about them).
13. Allowance for expansion in steam pipes, train rails and bridges.
14. Expansion in the balance wheel of a watch.
15. Expansion tanks in attics where hot water heating is used.
16. In nature: ice for man; water in lakes; rain clouds; water vapor for health.
17. Copper kettles on stoves.
18. Metal thermometers.
19. Copper kettles do not melt on a stove.
20. Water in a car radiator does not normally boil in summer.
21. Ventilating rooms; foul air leaves at the top of a window.
22. Hot water tanks on stoves; the hot water is taken off at the top.
23. Radiators and radiants for heating; heat from a stove.
24. We can shut stove off when cooking in the heat of summer and use the fireless cooker.

You should try to discover other applications in addition to those above and tell about them in your science note book. Read about the applications listed above from you text book.

APPENDIX 5

A test on the Heat Unit

APPENDIX 5. A Test on the HEAT Unit.

A TEST ON HEAT

FOR CORRESPONDENCE STUDENTS AND THOSE DOING SELF-STUDY.
(Do not refer to texts or notes; be honest with yourself).

NAME....................

ADDRESS................

SEX...................
(Boy or Girl)

AGE......................
(Years and months)

DATE......................

....

1. Explain the following:

   (a) An ice cream freezer is made of metal but the freezing mixture is put in a wooden tub.

   (b) Ice is placed in the upper part of a refrigerator.

   (c) Linoleum is colder on the feet than a carpet.

   (d) A fresh fire in a stove sometimes smokes.

(e) In building telephone lines in summer, the wires are not pulled tight but are allowed to sag. Why?

2. Suppose that Mr. Brown, just to be different from most people planned his new home with the hot water furnace in the attic. How efficiently would it operate, and why?

3. A neighbor's little boy heard that one should not touch his tongue to a steel rail on a cold day. (This is very very dangerous and should never be tried). He promptly tried it. Explain what happened and why.

4. Why can a thermos bottle keep liquids <u>cold</u> as well as hot?

5. Describe the construction and operation of an air thermometer. What are its disadvantages?

6. <u>A multiple choice test:</u>

Complete the following statements by underlining the proper word or words found in the brackets:

(a) Your face feels warm around a camp fire because of (convection) (conduction) (radiation)

(b) If a house radiator were filled with ice water in summer, the air above it would move (upward) (downward) (sideward)

(c) A device that uses chiefly radiated heat to cook food is a (fireless) (pressure) (vacuum) cooker.

(d) Water will heat most rapidly when the heat is applied to the (top) (bottom) (side) of the container.

(e) Iced tea will cool most quickly when an ice cube is at the (top) (center) (bottom) of the tea.

(f) Frost forms on glass windows but not on the window frames because glass is a (better conductor) (poorer conductor) (better radiator) of heat than wood.

7. Write the number of the correct answer on the short line to the right.

Example:

Woollen clothing is warmer than cotton because:
(1) it has many pores, (2) is obtained from sheep,
(3) is heavy. (1)

....

(a) The main purpose of a car radiator is:
(1) to improve the car's appearance, (2) to cool the water, (3) to make the water circulate around the cylinders.

....

(b) Mercury rises in a thermometer because:
(1) the glass contracts, (2) the mercury expands when the thermometer is heated, (3) the air pressure varies.

....

(c) The source of nearly all the earth's heat is:
(1) coal, (2) the earth's interior, (3) plants,
(4) the sun.

....

(d) When heat is applied to a substance it makes the molecules
(1) move faster, (2) remain still, (3) move slower.

....

(e) Name the poorest conductor of heat in the case of
(1) wool, (2)silk, (3) cotton

....

(f) The sun's heat reaches the earth by
(1) radiation, (2) expansion, (3) conduction,
(4) convection

....

(g) In a hot water heater the hot water pipe is attached to the
(1) top, (2) bottom, (3) middle.

....

(h) Heat travels through an electric bulb by (1) friction,
(2) conduction, (3) radiation (4) convection.

....

8. Make a drawing to illustrate either a Hot Water Furnace System, Or a Hot Air Furnace System. Shade the smoke channel in gray and the heating ducts or pipes in red. Use arrows to show the direction of currents of air or of water.

9. Describe and illustrate an experiment to show that solids expand when heated. State one illustration of how man has to overcome this physical effect of heat.

APPENDIX 6

A unit study on <u>LIGHT</u>

APPENDIX 6. A Unit Study on LIGHT.

OUR AIMS IN MAKING THIS STUDY

1. To study about "LIGHT" in relation to yourself and your home.
2. To do a few simple experiments by yourself.
3. To try to gather pictures on the subject.
(Write to the Canadian General Electric Co., Toronto, and ask them for their pamphlet and charts on the "Development of Lighting".)
4. To start our study with a local treatment and then to extend it farther afield.
5. To continue the method of "Large Wholes" and "Sub-wholes" as a method of learning.
6. To guide your readings in the science text based on this "Mind's-eye" method of study.

....

Do not try to memorize these aims. They are merely for your information. When the unit is completed return and read them and see if they have been accomplished.

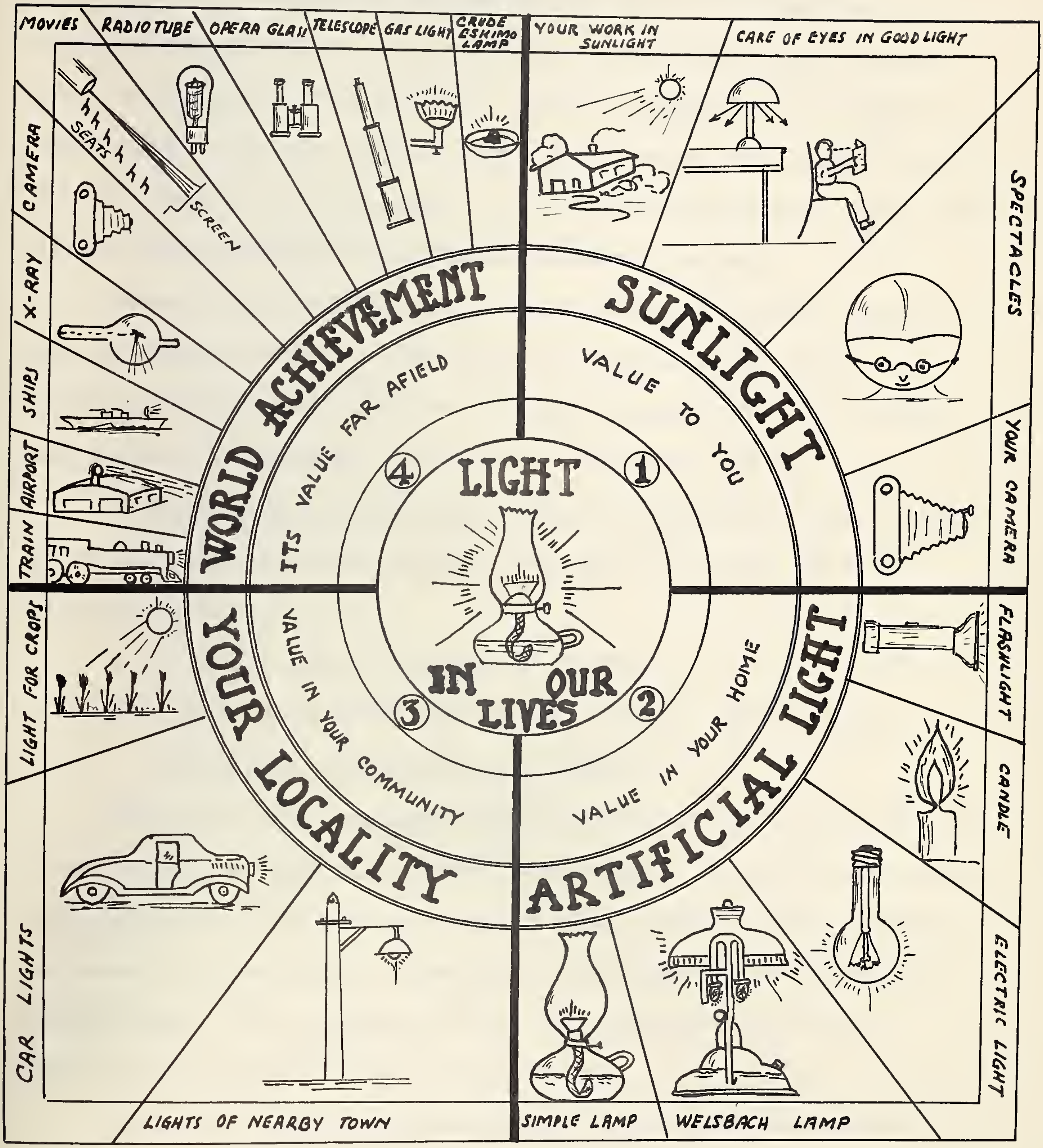
....

Time for the unit of study:

The study should not take longer than two weeks. It is rather a short unit and for this reason you may take less time than that.

LIGHT: IT'S WORK, USE AND CONTROL

THE OVERVIEW IDEA



Perhaps you would like to copy this diagram in your notebook.

The overview diagram on page 159is a "full-study-idea" of what light means to you, to me, to your folks, and to everyone in the world. Do you think it is interesting to study these diagrams so that you are able to see the whole picture at once? on one page? Are you beginning to "see" in your mind's eye the whole story of the value of light to man? If you ever go to University you will not study much more about light than just what this "whole-diagram" shows.

Have you ever paused to consider what a gloomy, dingy, and impossible world it would be if our sunlight were suddenly taken away from us? What a marvellous body is the sun which illuminates, and gives life to our earth!

On page 161is a bird's-eye view of our whole light study. We shall deal with the following studies as shown in the illustration:

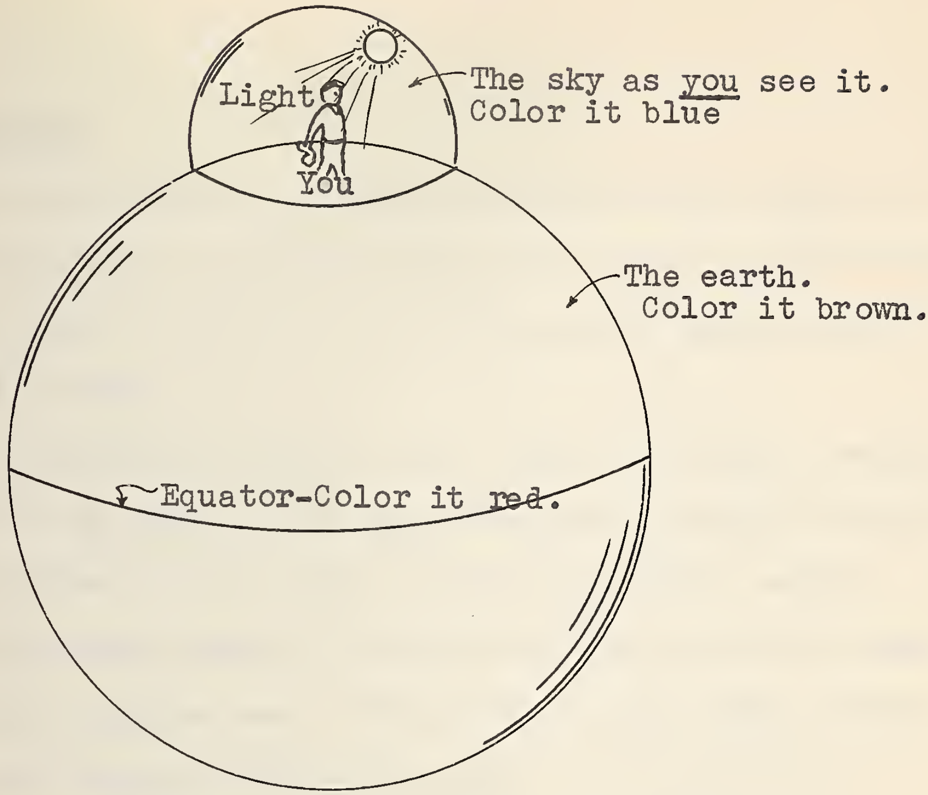
A - THE SUN AS THE SOURCE OF LIGHT.

B - ARTIFICIAL LIGHT OR MAN-MADE LIGHT, WITH SPECIAL REFERENCE TO LIGHTING IN HOMES.

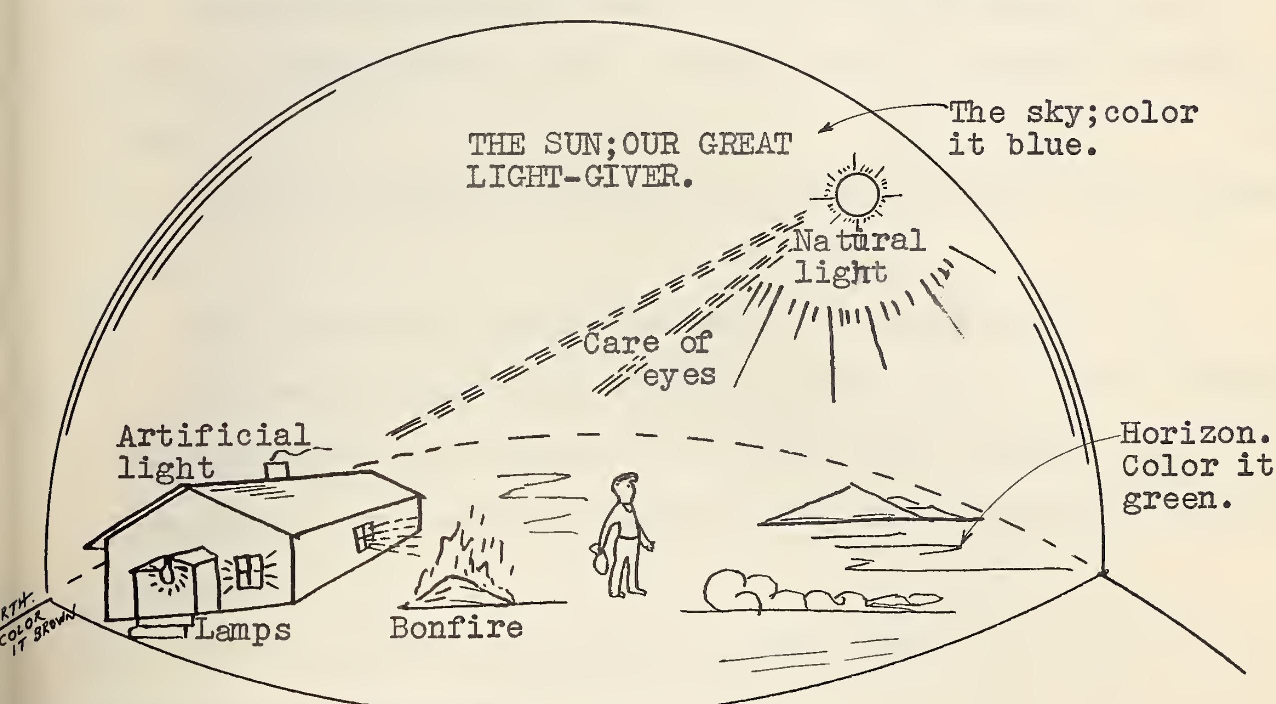
After you have examined carefully the picture on page 161 close your eyes and picture the two ideas. It is really quite easy isn't it. This is all we can study about light, except for some very wonderful inventions like cameras, telescopes, microscopes, field glasses, that tell how inventors have controlled light for their own purposes.

The lower sketch on page161indicates again how we are affected by light from the sun as it beats down on our own horizon. This is a similar idea to the one you learned about in our study of heat from the sun.

A BIRD'S EYE VIEW OF OUR LIGHT STUDY



LIGHT IN RELATION TO YOUR OWN EARTH-HORIZON



Copy these sketches in your notebook.
(Color lights, sun, bon-fire red)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

INTRODUCTORY

We should start by asking ourselves what light is. Whatever it is, it enables us to read, to see people, to do our work, and to attend to the business of living, and of making a living.

The scientist tells us that light is energy (energy is ability to do work). The sun gives light energy to plants to enable them to make food for people and for animals. This food is our only source of energy so that we see it comes indirectly from the sun. We have seen that light-giving bodies are usually heat-giving too.

A FEW THOUGHT PROBLEMS:

1. How fast does light travel? It travels so fast that it would go eight times around the earth while a person counts "one".

2. Why can a thousand people see the same object at the same time?

3. Why can we not see the stars in the day-time?

4. The sun is 93,000,000 miles from the earth. Light travels 186,000 miles in a second. If the sun were suddenly extinguished, how many minutes would it take for the earth to be darkened?

5. Whow is light "controlled" in your home?

How Light comes to us:

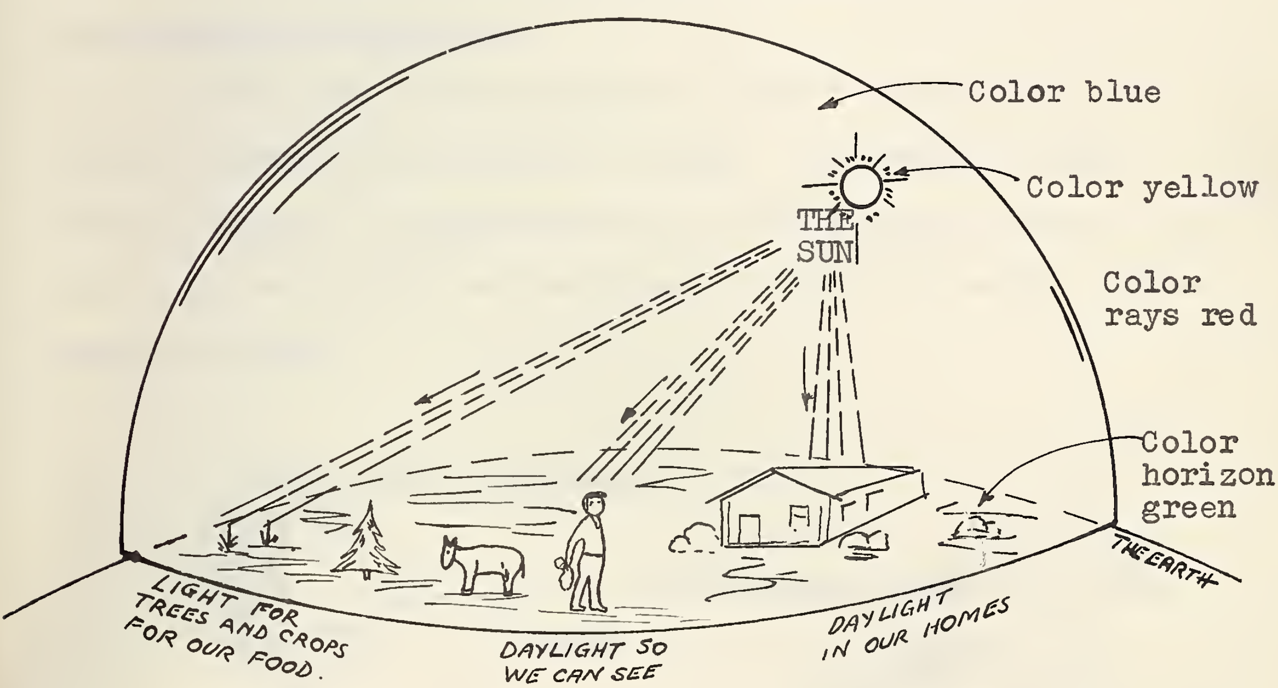
Different theories have been proposed to suggest how light comes to us. Some have indicated that the travel of

light consists of small particles which come direct to our eyes; others suggest that waves travel in the way that waves move along a rope that is fastened to a support and shaken at the other end; another theory imagines light to be a bundle of energy, several bundles of them in fact, which come to our eyes. Whatever the way light travels, doesn't really matter much, for it certainly gets to our eyes.

(A) THE SUN AS THE SOURCE OF NATURAL LIGHT

This is another "sub-whole" picture or smaller idea of what light means to us in our lives.

THE SUN AS THE SOURCE OF NATURAL LIGHT



THE SUNLIGHT MAKES LIFE POSSIBLE

Copy this sketch in your notebook

I am sure you will agree that the sun does work for us. It keeps the plant factory going in order that we may be fed. Our meat, sugar, bread, oatmeal, butter, all come to us because sunlight and sun heat make them possible.

Thus we see that light is very important to you in your home, in your community and to distant communities. Can you imagine a world without sunlight? How would it alter all your activities? How would it change the tasks your dad performs?

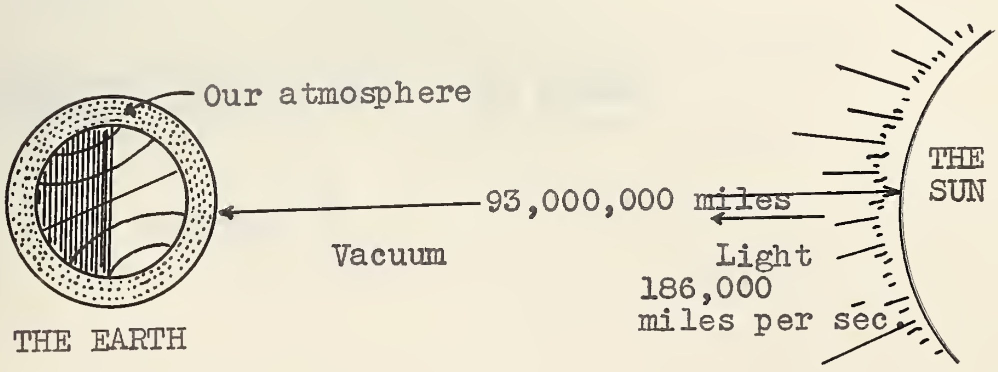
Now read your text on the subject "Light and its value to man".

Do Experiment No. 1. in "Experiment Manual B"

....

<u>Transmission of Sunlight</u>:

(a) The most recent theory of light transmission by radiant energy is the QUANTUM THEORY. It suggests that radiant energy is transmitted in a discontinuous manner, the radiating body giving off bundles or packets of energy called <u>quanta</u> of light.



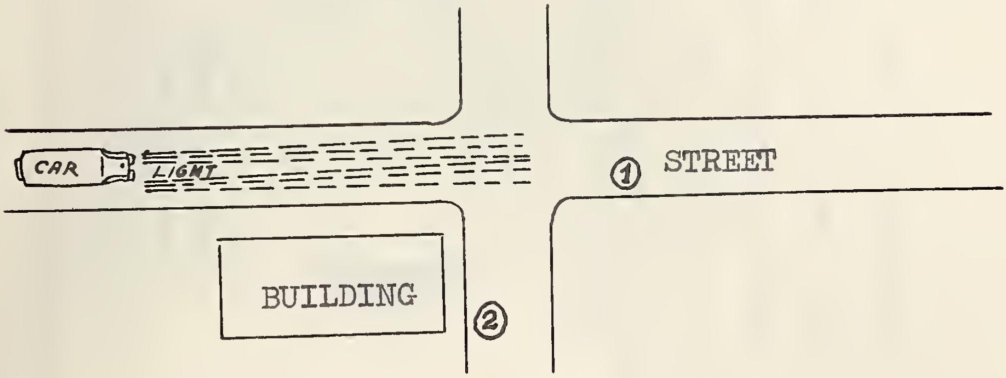
(b) Our atmosphere extends about 100 miles from the earth; the sun is 93,000,000 miles away from the earth; light travels through the great void or vacuum separating the earth and the sun.

(c) The simple sketch below shows a car with headlights approaching an intersection or corner. If a man were at position (1) he could see the direct light source but a man at position (2) could not because light cannot travel around a corner; we say that light travels in straight lines. For this reason we cannot see a person around a corner unless we use mirrors.

Light terms: Light terms are interesting and scientific.

(1) A luminous body: is one that gives off its own light e.g. sun, star, electric light, candle.

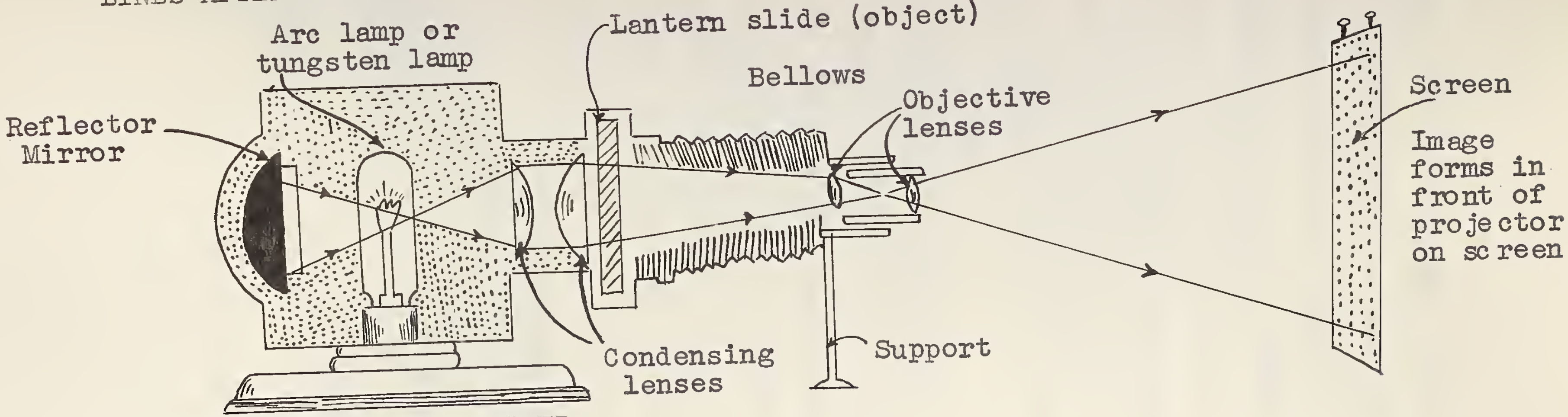
(2) An illuminated body: is one that is seen by reflected light, e.g. moon, planets, trees, houses, people.



THE PROJECTION LANTERN

Man Controls Light.

THE LENSES CHANGE THE DIRECTION OF LIGHT BUT THE LIGHT KEEPS MOVING IN STRAIGHT LINES AFTER THE CHANGE OF DIRECTION.



SCIENCE PRINCIPLES INVOLVED

1. Reflection of light from a mirror.
2. Change of light direction by lenses.
3. Light travels in straight lines.
4. Radiation of light from a lamp.

(3) <u>A ray</u>:a single straight "line" of light.

(4) <u>Diverging rays</u>:Rays spreading from a point.

(5) <u>Converging rays</u>:Rays moving to a point.

(6) <u>A Transparent medium</u>, transmits light freely so that objects are visible through it, e.g. glass, water, air,.

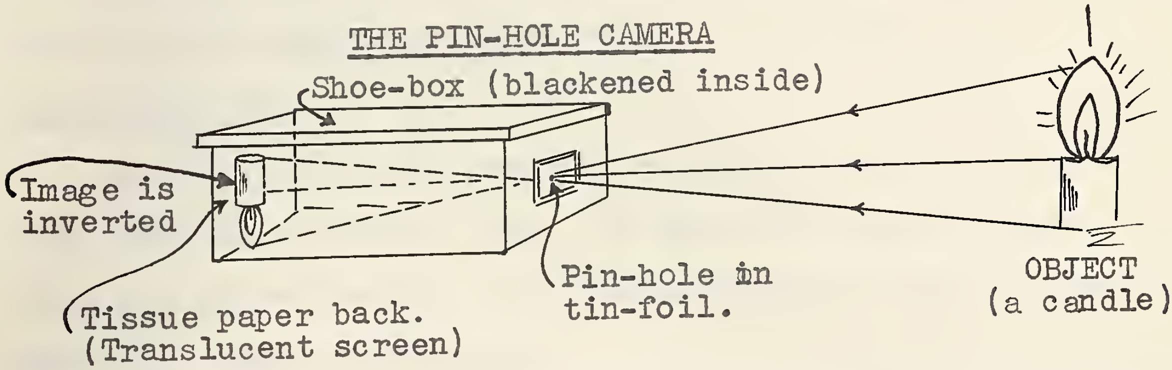
(7) <u>Translucent medium</u>:Resists light passage and diffuses it, e.g. frosted globes, waxed paper.

(8) <u>Opaque medium</u>: permits no passage of light rays, e.g. iron, wood, copper.

<u>Light travels in straight lines:</u>

The sketch below shows a crude camera, but all great inventions started in a crude way. Make a pin-hole camera like this and fit it up on a table in a dark room. Because light travels in straight lines the image on the back is inverted and reversed. It is a bit fuzzy because more than one ray comes from each part of the object.

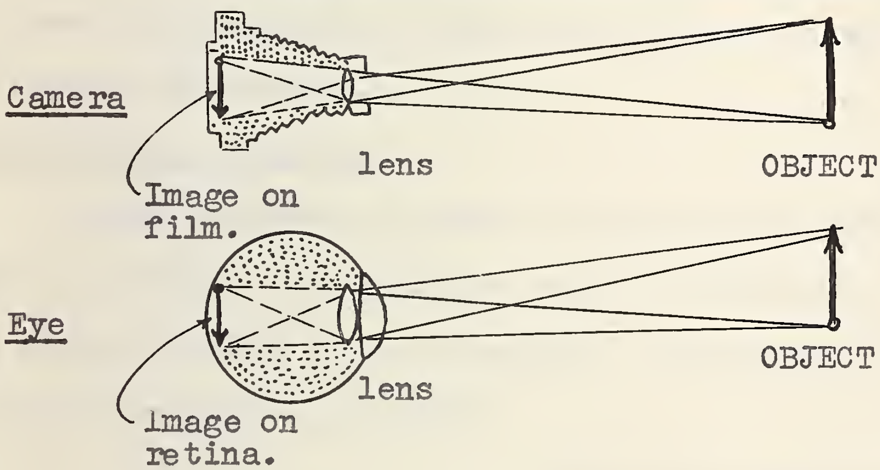
THE PIN-HOLE CAMERA



(Throw a cloth cover over the back of the box and look under)

Now do Experiments 2 and 3, in "Experiment Manual B". It is interesting to compare a real camera which has a lens with the human eye. The diagram on this page shows how they are alike and how they differ. Study the diagram carefully and copy it in your notebook.

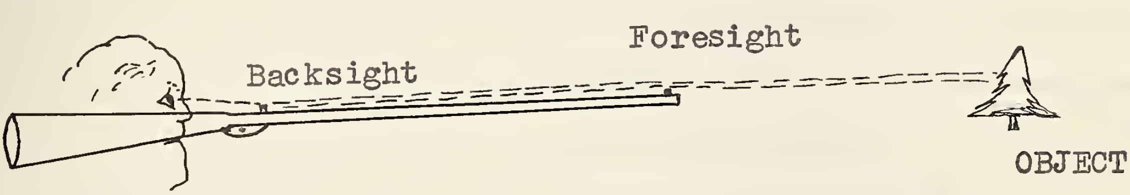
COMPARING THE EYE AND THE CAMERA



The lens of the eye transmits rays to the retina. The lens of the camera transmits rays to the film.

Sighting a gun:

If light did not travel in straight lines it would be very difficult to use a gun. We make the line of light from the object to the eye coincide with the line of light from the sights to the eye.



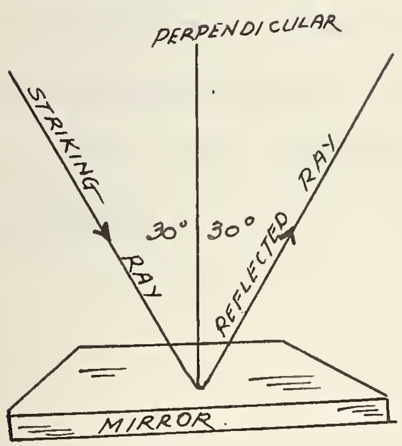
SIGHTING A GUN

Now do experiment No. 4 in "Experiment Manual B".

A further example of light travelling in straight lines is the way light travels after going through a knothole of a door or wall. The lighted dust particles form a dust-beam which shows up the line of light. A moving picture projector illustrates the same principle of light travelling in straight lines. As we look up toward the ceiling we note the straight lines of dust-beams.

Reflection of light:

Light striking a smooth surface is reflected. A tennis ball striking a hard tennis court is reflected; if it strikes a ploughed field it is "absorbed". The simple sketch below shows how light is reflected.



Note the direction of the striking ray and the direction of the leaving or reflected ray. Note that they are the same, in relation to a perpendicular to the surface.

Now do experiment No. 5 in "Manual B".

The periscope is an application of the principle of reflection and is used in trench warfare and in submarines.

Now do experiment No. 6. in "Manual B".

This finishes our treatment of Natural Light. Return to the overview diagram and take a glance at it. Now go on to the type of light which man makes.

(b) ARTIFICIAL LIGHT.

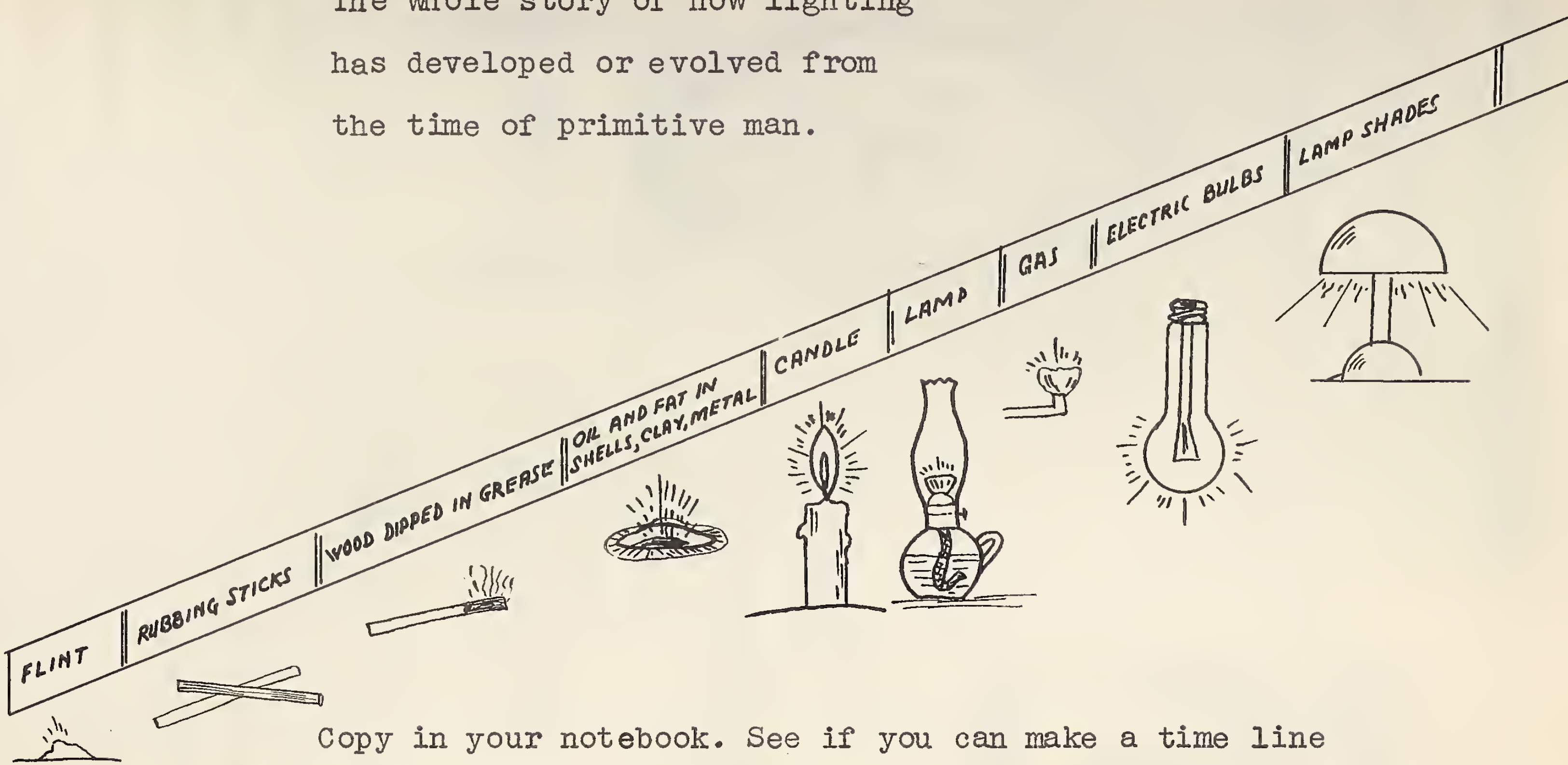
Man could not use sunlight in his dwellings at night so he set out to make light of his own in order to prolong his activities. Look up the word 'artificial' in the dictionary.

Write to the Canadian General Electric Co., in Toronto and ask them for their booklet and chart on the "Story of Light". Tell them you are a Correspondence Student.

Isn't it remarkable to see how man works with the materials of his environment because he needs to do so. He renders his life, and yours, and mine, more pleasant and convenient by his inventions. The picture sketch on page 171 shows you the whole story of 'light progress' all on one page. It really seems to be the natural way of trying out and of improving mistakes. That is the way you would work if you started building boats: the first one would be fairly well made and the others would be better because you learned from your mistakes.

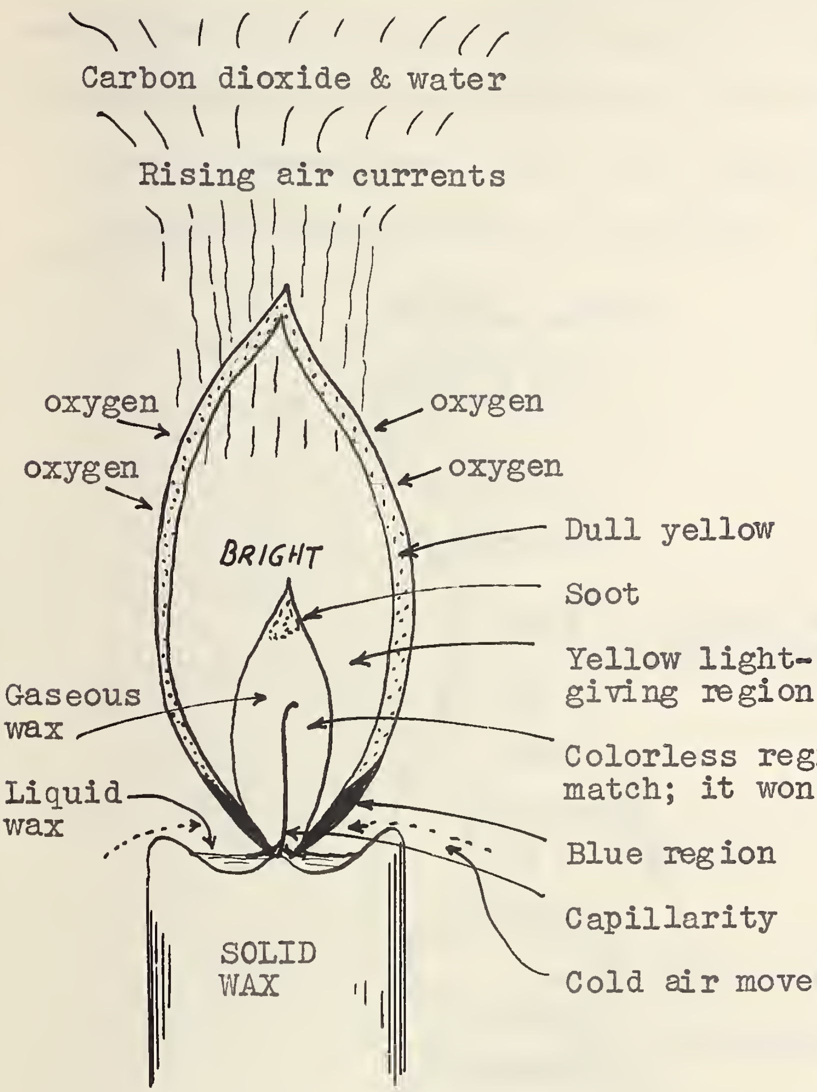
THE STORY OF ARTIFICIAL LIGHTING

The whole story of how lighting has developed or evolved from the time of primitive man.

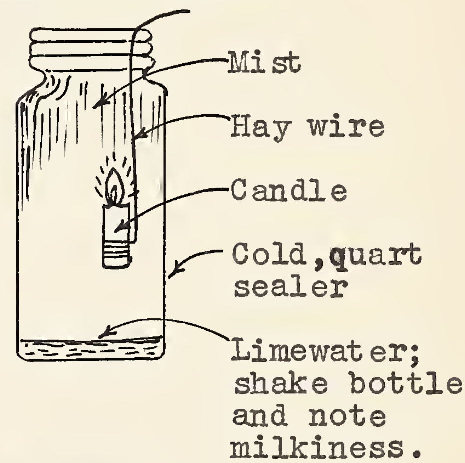


Copy in your notebook. See if you can make a time line of this study, discovering dates for each stage of progress.

2. <u>A candle is an interesting study:</u>



<u>To test for products of the flame.</u>



(Copy into your notebook and color suitably)

A simple study like that of a candle really tells us a great deal about science. Remember science means to 'know', and to 'know systematically' and in an organized way.

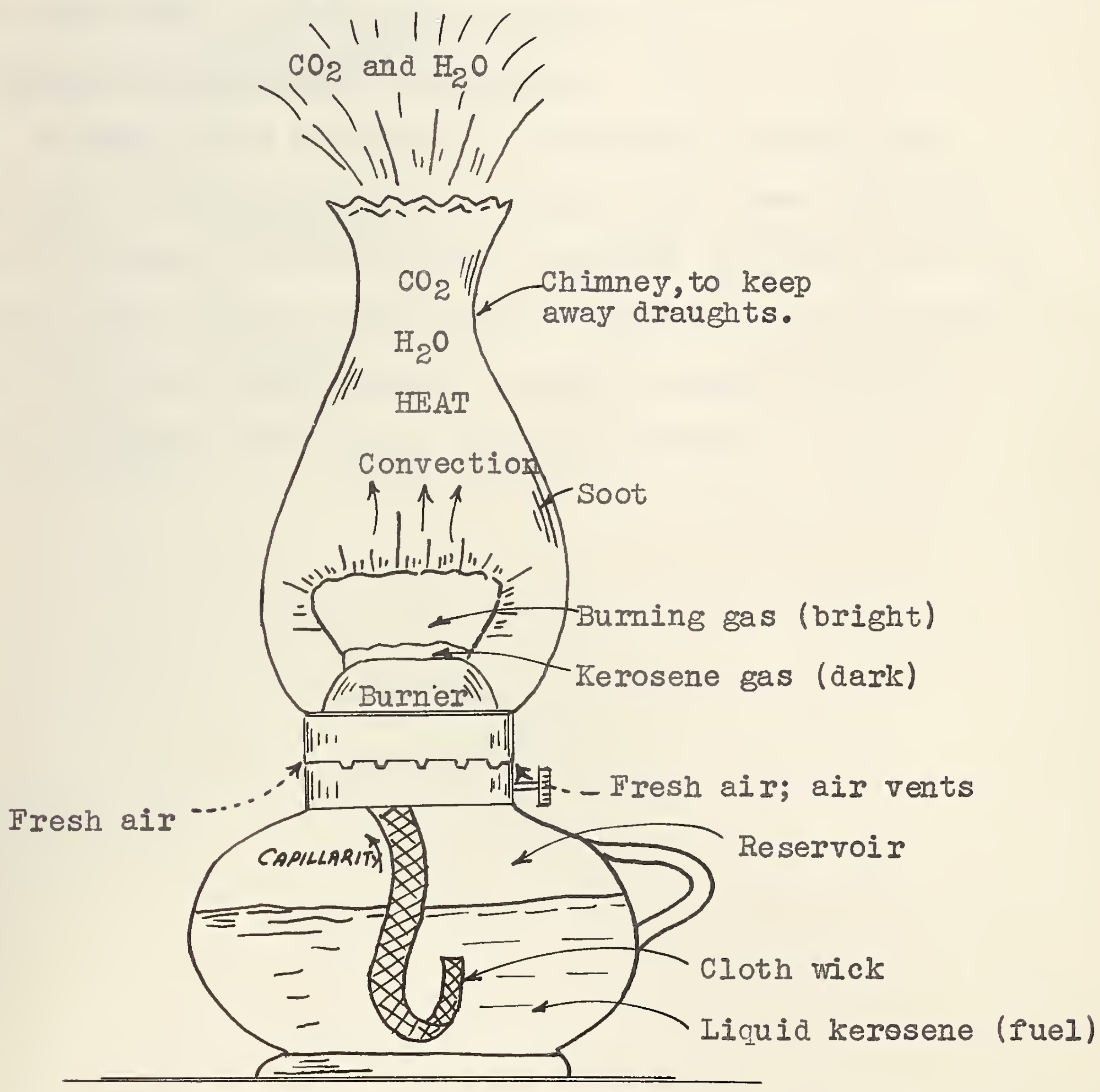
A candle is a miniature light factory. In pioneer homes people made their own candles out of tallow but they did not know as much <u>about</u> the candle (its science) as you know.

They were not 'budding scientists' as you are now. You will never know all about our world and our environment, but isn't it interesting to delve into it as far as you can?

Now do Experiments 7 and 8 in "Manual B".

Read your text on the Candle Flame.

AN 'OIL' LAMP



Copy this diagram and label it.

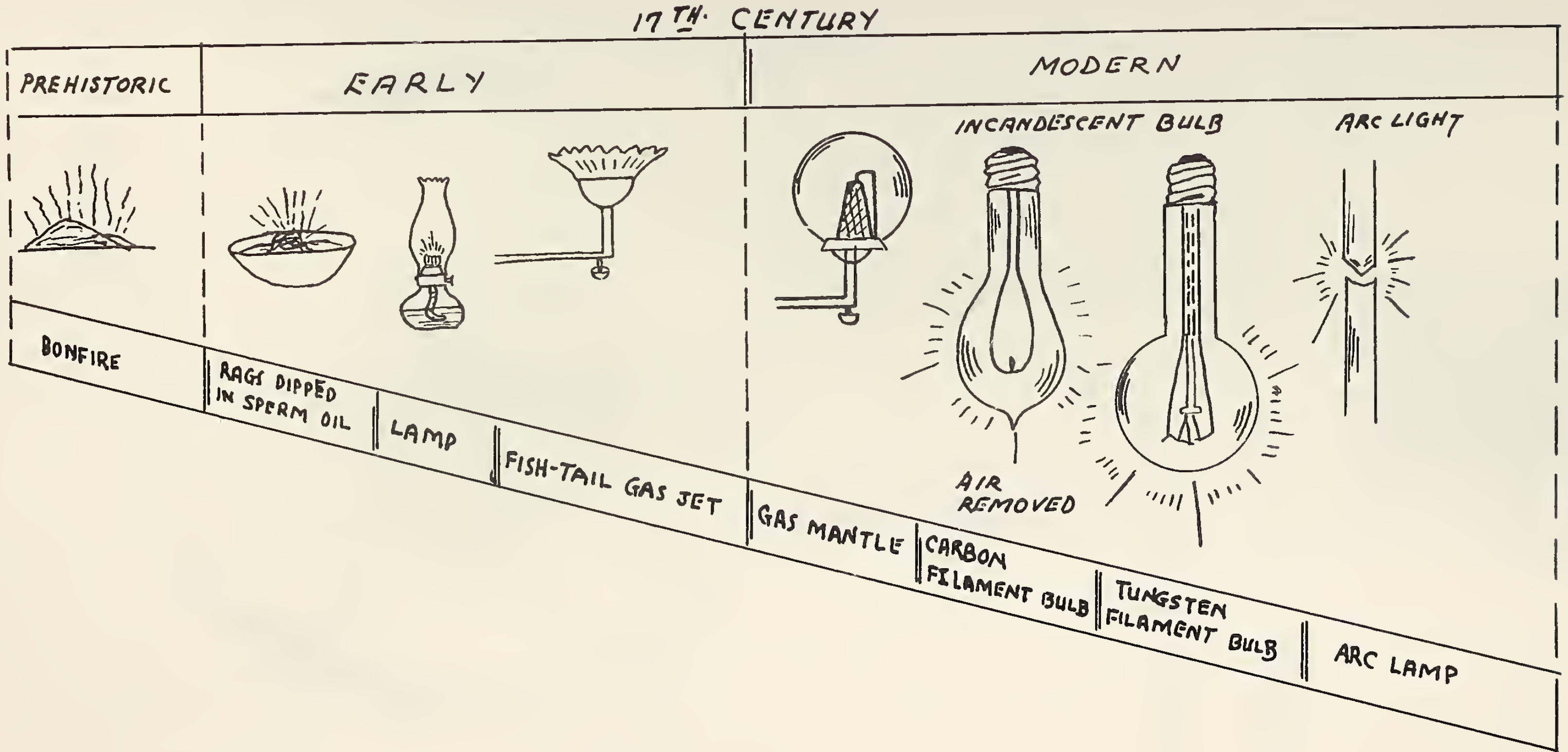
The lamp is a refinement over the candle just as a car is a refinement over the buggy. But really the ideas we found out in the candle study are exactly the same in the lamp.

The lamp is just another invention designed to lengthen the day for you and your folks, in order to do more work, make more money, or to have visitors in.

4. Kinds of Artificial Illumination.

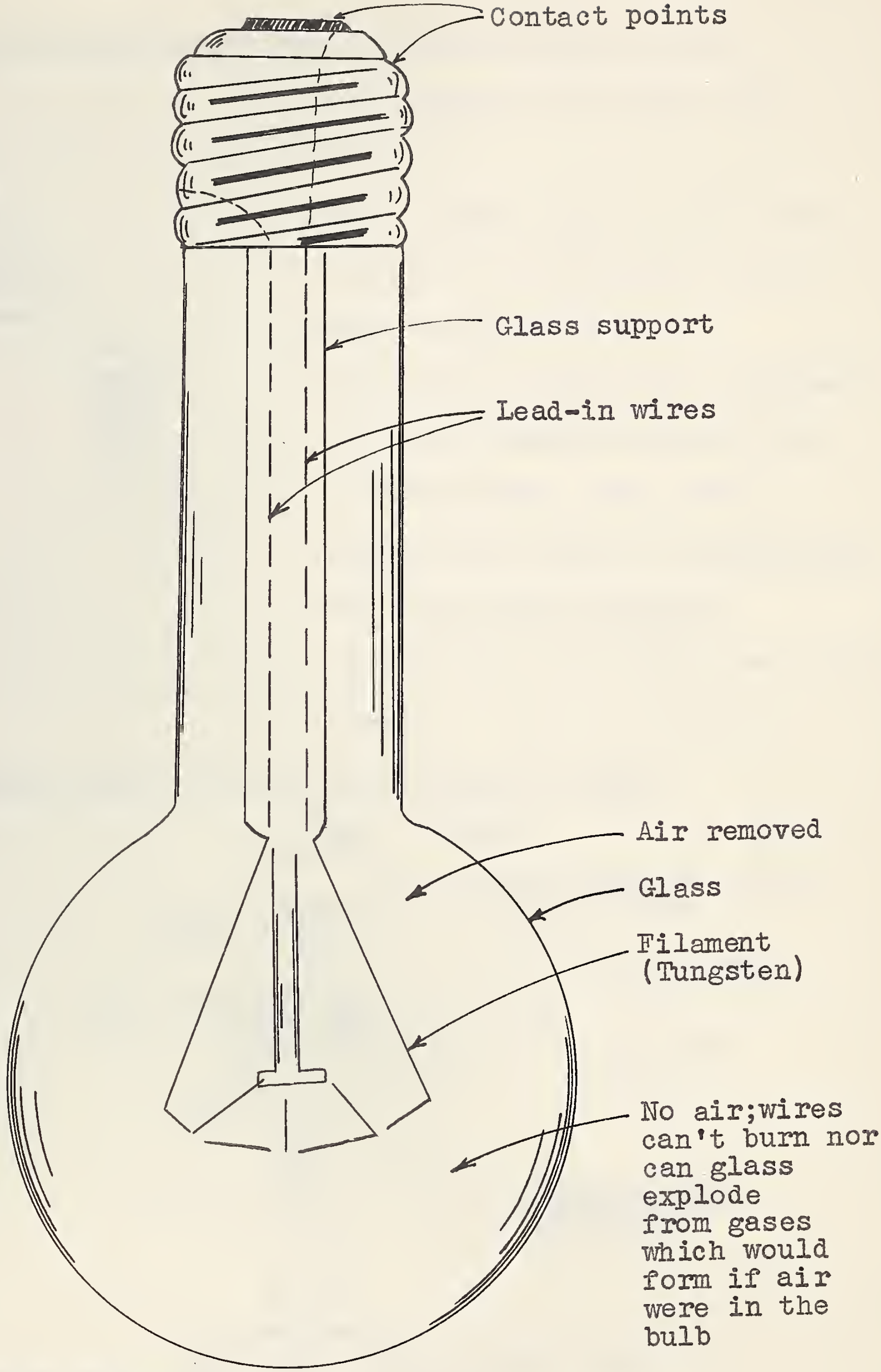
On page 175 is a picture of the story of artificial lighting. It is a "sub-whole picture" and shows the story all at a glance. Can you close your eyes and see it in your 'mind's eye', all at once? And can you picture pre-historic man in his dark cave, and man at later stages in his hut, then in shacks, and finally in modern homes?

ANOTHER WAY TO THINK OF THE STORY OF LIGHT



Copy this diagram in your notebook if you think it is worth keeping.

THE INCANDESCENT LIGHT



COPY IN YOUR NOTEBOOK.

5. Light in relation to our eyes: (How you should study)

(a) Light not too bright nor too dim.

(b) No direct light in the eyes.

(c) Lamp to be a little higher than the head.

(d) Light over the left shoulder.

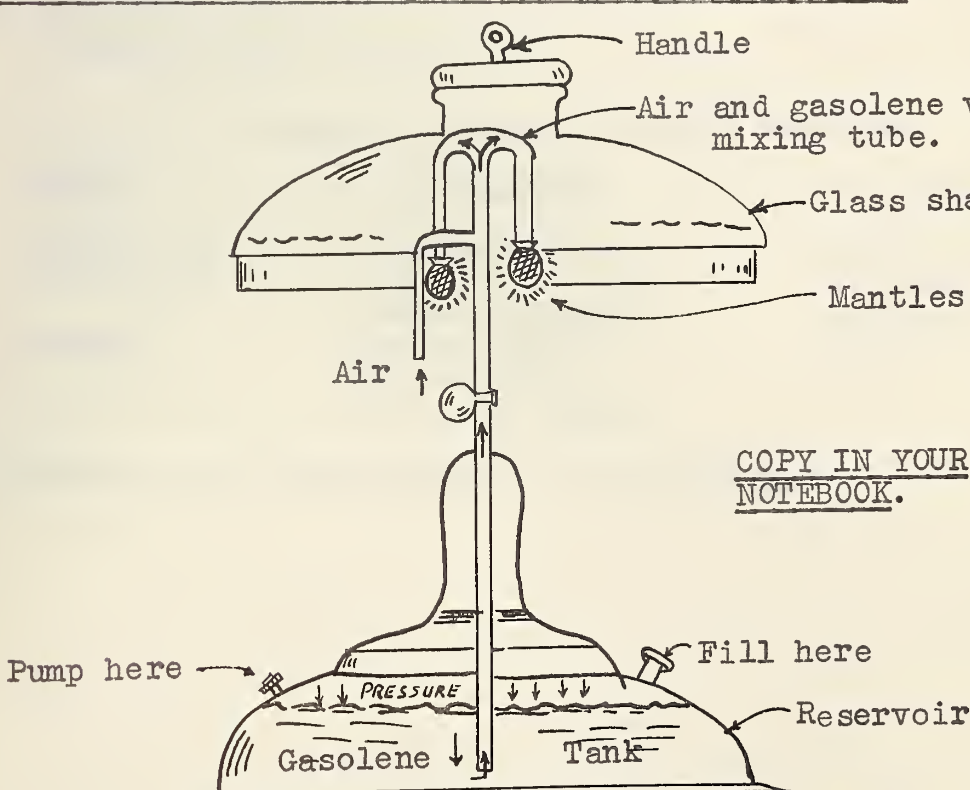
(e) Do not read in moving cars.

(f) Do not read lying down.

(g) Rest the eyes by looking away from your work by spells.

(h) Give the eyes extra rest during illness.

6. The Welsbach Mantle lamp is an interesting study.

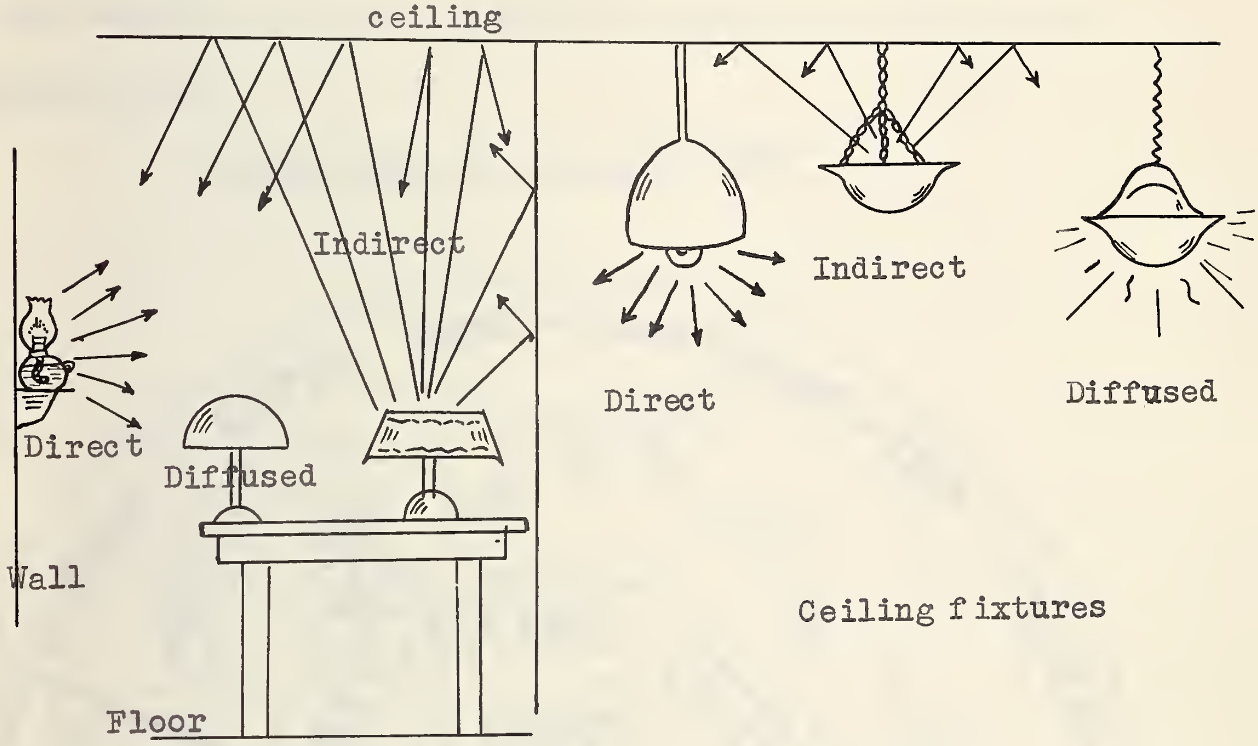


COPY IN YOUR NOTEBOOK.

Consult your text on: Light and our eyes, and the Welsbach mantle lamp.

7. Methods of Lighting: (How we control light in our homes)

The three types of lighting are (1) Direct (2) Indirect and (3) Diffused. The sketches illustrate the three types.



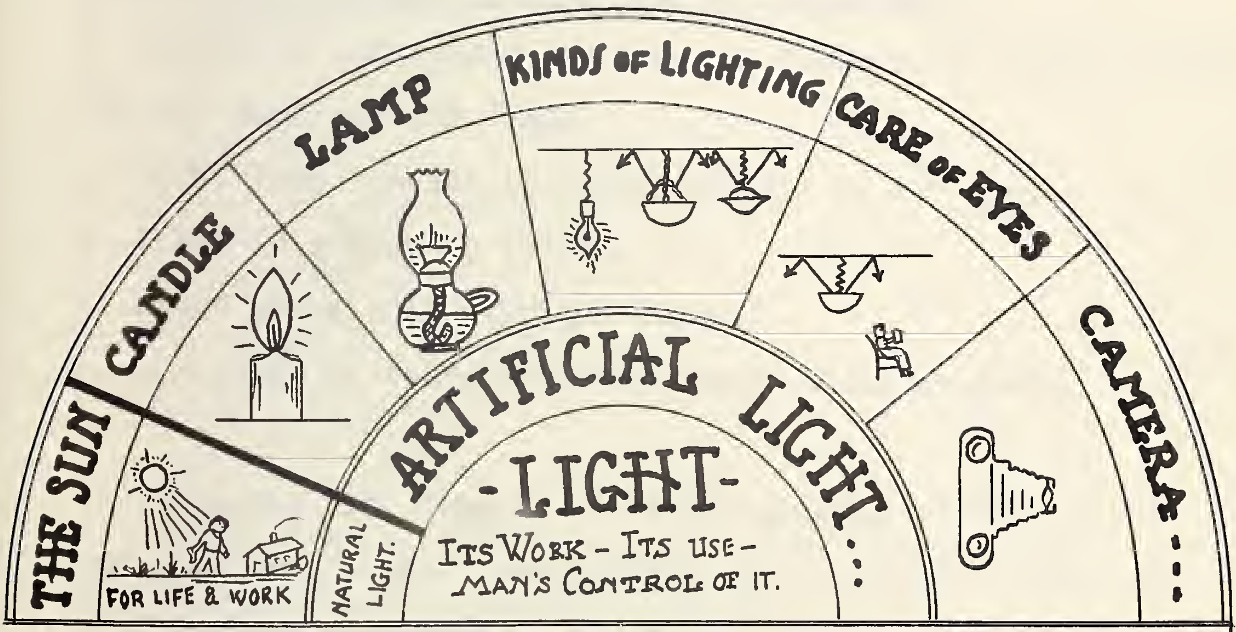
Copy this diagram in your notebook.

1. DIRECT	2. INDIRECT	3. DIFFUSED.
Bright and glaring. Harmful.	Opaque reflector. Light reflects from ceilings and walls. Best for eyes.	Light fully enclosed in translucent shade.

Consult your text on methods of lighting.

Now let us see if you have 'caught on' to the <u>whole</u> study of light. The diagram below is the summary of our study. If you were asked any questions about "LIGHT AND ITS WORK FOR US" you could "see" the question as a part of our <u>whole</u> study.

A WHOLE VIEW OF THE LIGHT STUDY



Copy this diagram in your notebook. Could you make one something like it?

<u>A REVIEW SUMMARY</u>: In tabular form.

<u>LIGHT AND ITS WORK FOR US</u>.

(A) <u>General Ideas</u>.

1. Source of light.
2. How our homes are lighted by the sun.

(B) <u>The Camera</u>.

Light travels in straight lines.

(C) Artificial light.

1. Candle
2. Lamp.
3. Gas.
4. Incandescent lamp.

(D) Lighting in Our Homes.

1. Arrangement.
2. Preventing eye-strain.

OUR GENERAL PICTURE IN THE FORM OF STATEMENTS.

1. Light has lengthened the day for pleasure and work because man has made his own light.

2. Light from the sun is indispensable in our lives.

3. Light is a form of energy.

4. Light travels in straight lines.

5. Light may be reflected from smooth shiny surfaces.

Can you list five or ten other general statements on what you have learned about light and the work it does for us? Think of your "whole" diagrams.

....

LIST THEM HERE.

1.____

2.____

3.____

4.____

5.____

6.____

7.____

Now read your text through on the subject of "LIGHT"

YOUR FINAL REPORT TO ME ON YOUR LIGHT STUDY.

(Tear out these test pages and send them to me)

1. Fill in this tabulation: List five substances under each heading.

	TRANSPARENT.	TRANSLUCENT	OPAQUE
1.	....	....	....
2.	....	....	....
3.	....	....	....
4.	....	....	....
5.	....	....	....

2. State four applications to the principle: "Light travels in straight lines".

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

3. Fill in the table below:

PERIOD.	MAN'S METHOD OF SECURING LIGHT.
1. Primitive times	______________________
2. Middle Ages.	______________________
3. Modern times.	______________________

4. State briefly two theories of Light Transmission.

(a)

(b)

5. What is the value of light walls in schools and homes?

6. How does light get to us from the sun?

7. You wish to make a camera. (A) What four essential parts must you procure? (B) What is the function of each part?

PART FUNCTION.

(1) .... ____________________

(2)............... ____________________

(3)................ ____________________

(4)............... ____________________

8. Name four important parts of the human eye and state the use of each part.

(1)............... ____________________

(2)................ ____________________

(3)............... ____________________

(4)............... ____________________

9. We note that the inside of a camera is painted black. Why?

10. Give four rules for proper care of the eyes in reading.

(1)____________________

(2)____________________

(3)____________________

11. As a car driver, state 2 ways in which light reflection may help you avoid accidents.

(1) ____

(2) ____

12. Describe an experiment to show that light travels in straight lines.

13. Write a short composition on the life of Edison and his invention of the incandescent lamp.

14. Make a carefully labelled diagram of a Farm Lantern.

15. You wish to make a periscope to view a parade over the heads of taller people. Make a sketch to show how you will do this with plane mirrors.

Note:

In writing an account of an experiment always use these headings in the margin.

1. Title:	Light
2. PURPOSE:	To prove.......etc.
3. MATERIALS:	List apparatus used.
4. METHOD:	Start with a diagram sketch. Tell briefly what was done
5. OBSERVATION:	What was noted.
6. CONCLUSION:	Is the purpose achieved? Tell why.
7. APPLICATION:	What is the life application of a practical nature?

....

Memo: A good student writes out all his experiments in a notebook.

A good student makes sketches, and labels them in his notebook.

This is the end of our acquaintance together for now. Will you please write me and tell me what you think of the method of "WHOLES". Please tell me whether you find the diagram summaries (pre-view and re-view) (also the sub-wholes) of value in learning about the units we dealt with. I should very much like to have your opinion. Do you think it is worth while? Do you think it makes the learning of science easier? Do write me and tell me all about it.

Good luck to you in your education. And thank you for being so kind as to work with me in our little experiment together. I wish I could meet you personally.

Very sincerely,

....

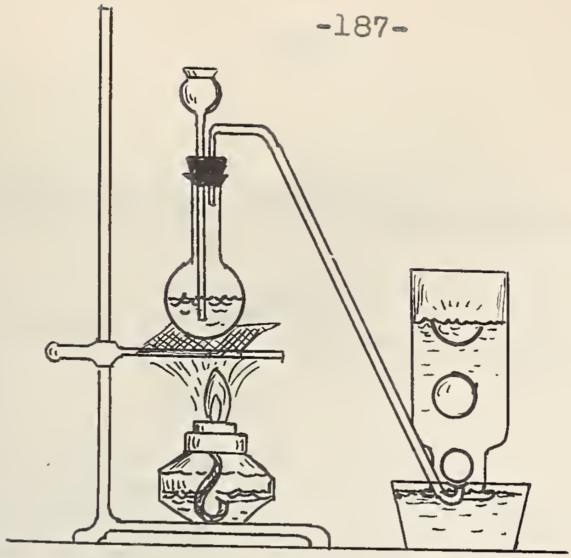
APPENDIX 7

MANUAL B

Guidance of laboratory work

on the

<u>LIGHT</u> unit.



AN EXPERIMENT MANUAL

On
-THE "LIGHT" UNIT-

Things to do during your

study of Light.
(some real fun)

A: SUN-THE SOURCE OF LIGHT

B. ARTIFICIAL LIGHT & HOME

LIGHTING.

@@@@@@@@@@

Practical applications at
the end of the Manual.

Name--------------

APPENDIX 7. MANUAL B.

Guidance of Laboratory Work on the LIGHT Unit.

CONTENT OF THIS EXPERIMENT MANUAL

SECTION A:
(The sun as the source of light)

SECTION B:
(Artificial light in homes)

....

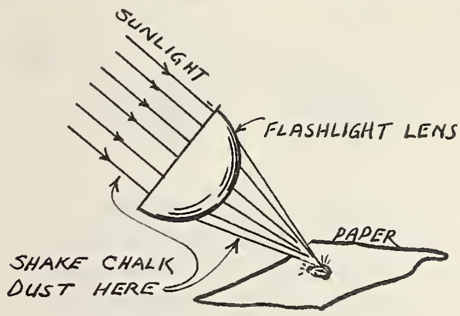
YOUR EXPERIMENT KIT

LIGHT STUDY

Candles
Cardboard
Cocoa can
Corks
Lens, flashlight
Limewater
Mirrors, small

SECTION A

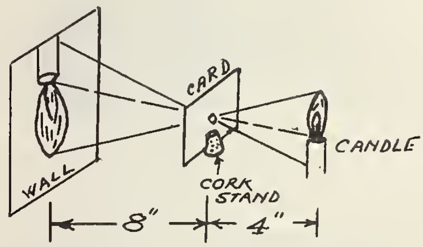
EXPERIMENT No. 1. The sun as the source of light.



Experiment out of door or in a room facing south on a sunny day. Concentrate sunlight using a flash light lens, on a piece of paper. Shake chalk dust or have smoke from smoldering string light up the sun's rays.

Due to sunshine and the spinning of our earth on its axis, we have regular succession of day and night.

EXPERIMENT No. 2. To show that light travels in straight lines.



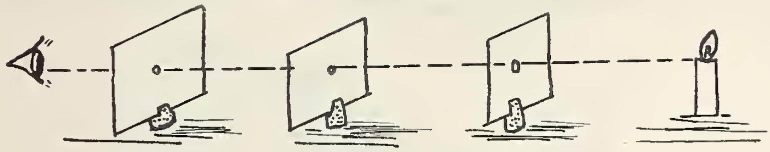
Between the wall and a candle place a small card having a tiny hole in its centre. (Do this in a darkened room)

Examine the patch on the wall, its shape, and its position.

Try to explain.

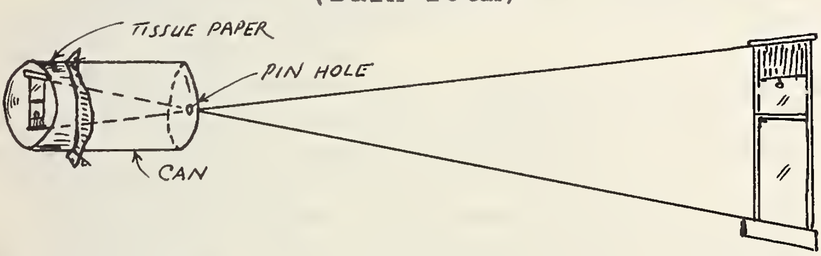
SECTION A

EXPERIMENT No. 3. To show that light travels in straight lines.



Make small holes in the centre of each of three cards. Insert the cards in corks which act as stands. Arrange the candle in front of the cards as shown and adjust the cards in such a way that by looking through all three holes the candle flame is seen. In what kind of a line are the three holes? What does this show about the direction in which light rays travel? Isn't this the same technique as in sighting a gun?

EXPERIMENT No 4. To make a pin-hole camera. (Dark room)



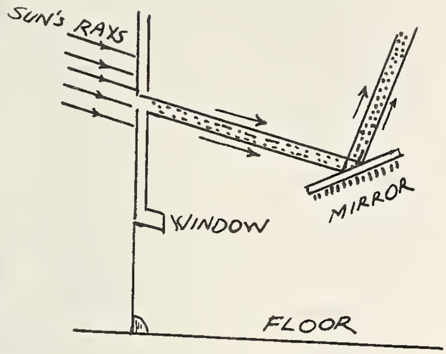
Cover the open end of a cocoa or coffee tin with tissue paper. Punch a small hole in the closed end with a needle.

Direct the hole toward a candle or toward a window through which light enter. If the room is fairly bright put the can in a coat-sleeve and look through the sleeve.

Let someone stand in front of the window and see if you can see them in the can.

SECTION A

EXPERIMENT No. 5. To show that light may be made to change direction.



Pull down the window blinds in a room and make a small hole with a needle through the blind. A small hole like this will really do no harm.

The window should be on the south of the house and the day should be sunny.

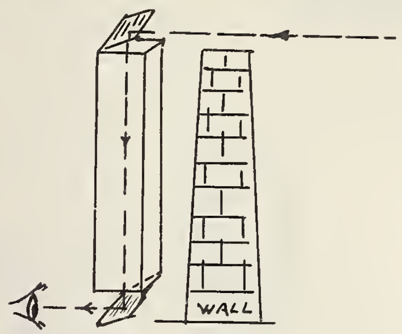
Dark brown paper over the window will do just as well and there will be no objection to making a hole in it.

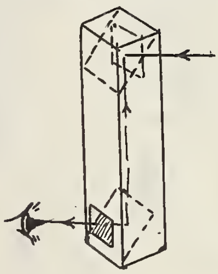
Now experiment with the size of hole and allow the light ray to strike a mirror, as shown. Trace the reflected ray by bringing smoldering string near the mirror.

Of oourse you can trace the reflection on a wall but this is not as interesting as actually seeing the ray with chalk dust or smoke.

SECTION B

EXPERIMENT 6 - To make a Periscope

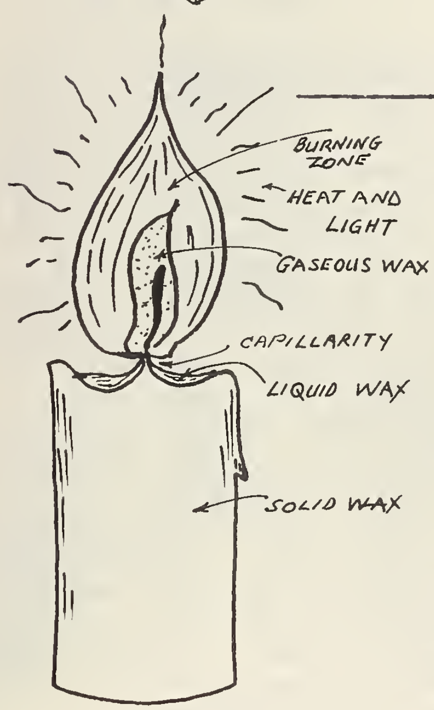




Make a cardboard tube as shown. Set two mirrors at 45 degrees into each end. This is the 'periscope eye' of a submarine. These periscopes were used during the royal visit in 1939 to enable people to see over the heads of the crowds.

In the upper figure the mirrors may be held in place with the hands or by using plasticene.

The lower figure shows the mirrors set into the periscope tube.



EXPERIMENT No 7. A Candle Study.

The candle flame gives off radiant energy in the form of heat and light. The central 'cone' is gaseous wax just about to be burned. It is therefore not luminous.

The light comes from the part surrounding the non-luminous part. This is the region where the gas unites with oxygen, giving off light.

SECTION B

EXPERIMENT No. 8. To examine the products of a flame.

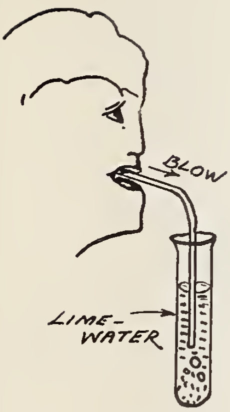


FIG. A.

FIG. B.

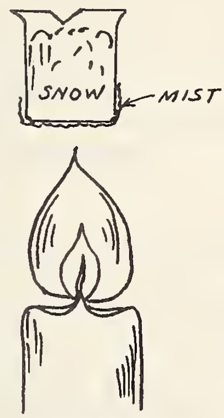


FIG. C.

FIG. D.

Figure A. Mix a little slaked lime in hot water and filter the solution. Put a bit in a test tube and breathe into it. The milkiness is a test for the carbon-dioxide of the breath.

Figure B. Moisten the inside of a beaker or test tube with some of the clear lime-water and hold the beaker inverted over a flame. Note the milkiness of the lime-water. What does this tell you about one product of flames?

Figure C. Fill a beaker or test tube with snow and wipe the outside perfectly clean. Then hold over a flame for a moment (not long, because of candle soot). Note the film of moisture, a product of the candle flame. The hydrogen of the wax unites with oxygen of the air to make water.

Figure D. Pour about $\frac{1}{2}$" of lime water in the sealer and with a wire hold a burning candle in the bottle. Shake the limewater up.

PRACTICAL APPLICATIONS.

EXPERIMENT NUMBER:

1. Solar machines to heat water for steam (Not much in use.)

   Boy scout fire-making with a lens.

2. As for Expt. No. 4.

3. Sighting a gun.
   Reaching for any object.
   Projection lantern.

4. The camera
   The marvellous eye of man.

5. Mirrors in homes and barber shops.
   Helioscope (Sun signalling machine) using mirrors.

6. Submarine and trench warfare using periscopes.

7. Principle of furnace heating.
   Lamps and Lanterns.

8. Chimneys on stoves to remove foul gases.

APPENDIX 8

A test on the *Light Unit*

APPENDIX 8. A Test on the LIGHT Unit.

A TEST ON LIGHT

FOR CORRESPONDENCE STUDENTS AND THOSE DOING SELF-STUDY.
(do not refer to texts or notes; be honest with yourself).

NAME:............................AGE:.....Years.....months

ADDRESS:.......................DATE:.....................

SEX:..............................(Boy or girl)

....

1. Complete the following statements by filling in the blanks with suitable words.

   (a) Light travels in......................lines.

   (b) The speed of light travel is.......miles per second.

   (c) The film of a camera may be compared to the.........
   of the eye.

   (d) The Iris of the eye corresponds to the..............
   of the camera.

2. Given two pieces of black cardboard with a small hole in the centre of each, a candle, and a table:

   (a) What might you demonstrate with this apparatus?

   (b) Make a labelled diagram of the apparatus as you would use it.

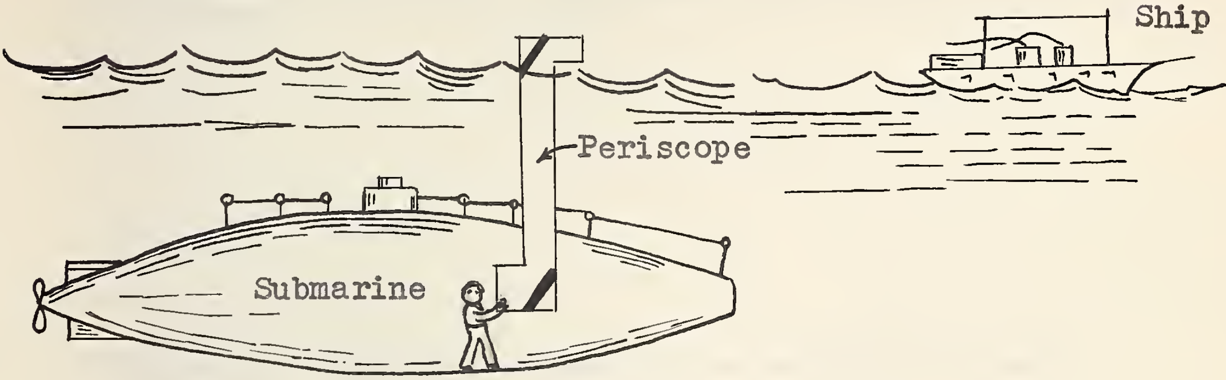
   (c) State an application of the principle involved as you have observed it.

3. State a theorgy which tries to explain how light gets to us from the sun.

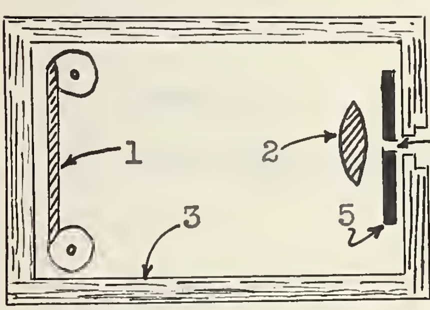
4. Discuss the value of light energy for continued life on the earth.

5. What is the value of light colored walls in a home?

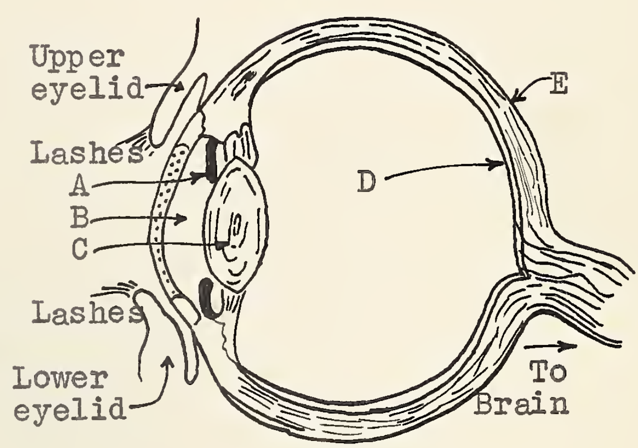
6. In the diagram below, draw lines to show the path of light rays from the ship, through the periscope, and to the eye of the observer.



7. The illustrations below show a diagram of the camera and the eye.



CAMERA



EYE

Give the letter that labels the part of the eye which corresponds to each of the following parts of the camera.

CAMERA	EYE
1.	..D.. (Example)
2.	.....
3.	.....
4.	.....
5.	.....

8. Make a sketch of the image of a flag on a pole, inside the pin-hole camera. Assume the flag and pole to be some distance from the camera. Show the rays from the object to the image.

9. Define the following terms with an example of each.

   (a) Luminous body:

   Example:

   (b) Illuminated body:

   Example:

   (c) Converging rays:

   Example:

   (d) Transparent medium:

   Example:

   (e) Translucent medium:

   Example:

   (f) Opaque medium:

   Example:

10. Write an imaginative essay on: "An Earth Without Sunlight".

APPENDIX 9

Questionnaire to Students

APPENDIX 9

Questionnaire to Students

QUESTIONNAIRE

To correspondence students and to students doing self-study.

1. Answer these questions carefully.
2. Write plainly.
3. Be honest and frank.

....

FILL IN THIS INFORMATION

NAME.........................ADDRESS..................

AGE..........................SEX.......................
Years and months at Sept. 1,1939. (Boy or girl)

QUESTIONNAIRE.

1. What has been your general impression of the 'method of wholes'?

2. What is the value of the home-made laboratory equipment plan?

3. What do you think of the plan of having a laboratory manual as a guide to experimentation?

4. As a result of our study together, do you appreciate science more than you did before?

5. Do you find it easier to recall the work you have studied in the 'bird's eye' view plan, than in the method of book reading? Why?

6. Do you find it of value to <u>copy</u> the diagram studies and charts? Why?

7. What is the value of diagrams, sketches and charts?

8. Is it easier to understand your text after doing the guidance work with me first? Why?

9. What do you think of the method of working alone?

10. Without a teacher, what do you think is most needed to make the 'lone' correspondence student able to fully understand his science work?

11. Could you tell me how you arrived at your <u>general</u> ideas in science? e.g. 'The Sun is the Source of all Energy'.

12. What benefit do you get from such diagrams as the 'Environment-Sky-Picture' which summed up the Grade 1X study.

13. What is the value of seeing the full Grade 1X course in your mind at the start of the year?

14. Which is the easiest type of picture to understand? Tell me why

(a) The animated sketch as on page 85 of the first book (The environment-Sky-Picture),

(b) The diagrammatic sketch on page 95 of the same book.

(c) The summary diagram on page 96 of the same book.

15. Tell me if you have benefitted from, or enjoyed studying the Heat and Light units and why. Give me your true opinion. Tell me just how you feel about them.

16. How are the Heat and Light studies different from your past methods of study?

17. Did you find it easier to do the Light Study after you had caught on to the method of the Heat Study?

APPENDIX 10

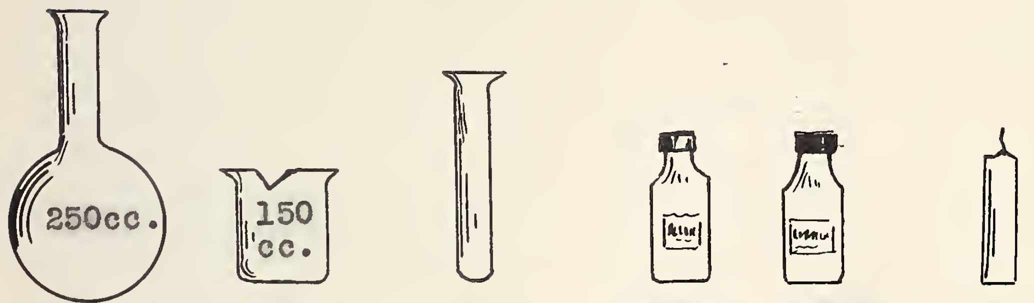
Experiment Kit supplied to each student

APPENDIX 10

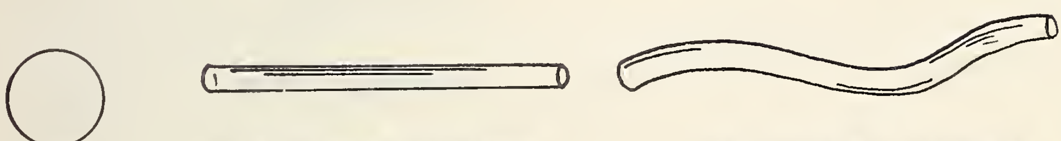
Experiment Kit supplied to each Student

EXPERIMENT KIT

(On loan to correspondence students)

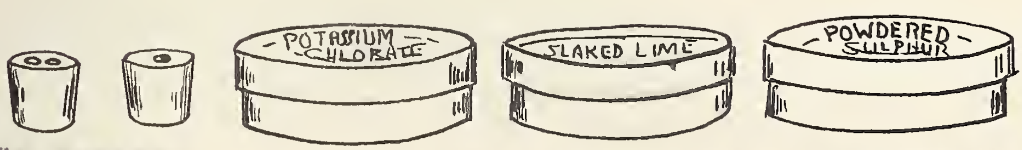


1	1	1	40cc.	40cc.	1
Florence flask	Beaker	Test tube	Alcohol	Lime-water	Candle



3 Filter papers	12" glass tubing	12" rubber tubing

Note: Instructions given in kit on folding of filter papers.



#4 Rubber stoppers 1 two-hole 1-one-hole	Ointment tin. Potassium chlorate	Ointment tin. Slaked lime	Ointment tin. Powdered sulphur

APPENDIX 11

Bibliography

APPENDIX 11

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